AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 9, No. 31. WEEKLY. | NEW YORK, JULY 31, 1886. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Fifteen-inch Shaper.

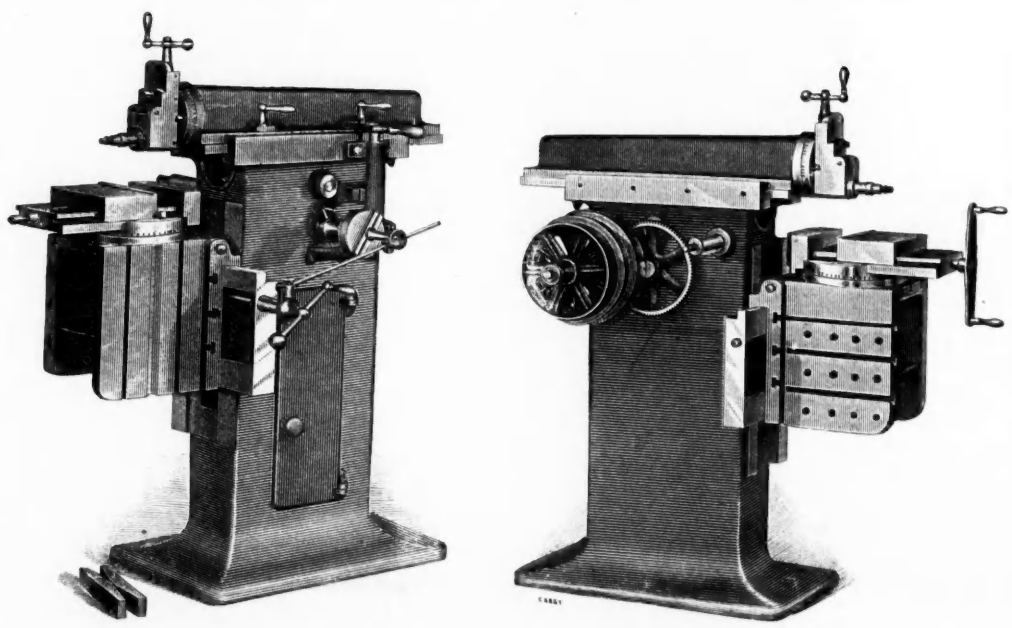
The engravings represent in two views this machine, made by the Hendey Machine Company, Torrington, Conn.; it embodies the latest improvements made by the company in machines of this class. It has a stroke of 15 inches, 15-inch cross-feed, and will plane a piece 14 inches high. It is adapted for all kinds of work done on a shaper, and is particularly recommended by the builders for use in tool-making and die work.

The reversing movement is such as to give accuracy of stroke (without crank). Length of stroke can be instantly changed while the machine is in motion, the uniformity of cutting speed being maintained constant.

The table is made in the form of a four-sided box, which secures strength and rigidity. This form also allows work to be conveniently bolted to sides as well as on the top. The vise can also be clamped to the side, which is convenient for many kinds of work. The adjustable table is made to be adjusted to plane any desired taper by the operation of a single screw. The table can be removed when it is more convenient to fasten work on saddle or front of machine. The machine is made with solid or fixed table, instead of adjustable table, if required. A bar of 2¼-iron can be passed under the cutter bar for cutting key-seats, and doing other work of a similar nature.

The cutter bar is driven by two rack gears of large diameter. The driving pinion and gear are on the outside, which permits the use of a large gear, and consequent strong driving of cutter bar.

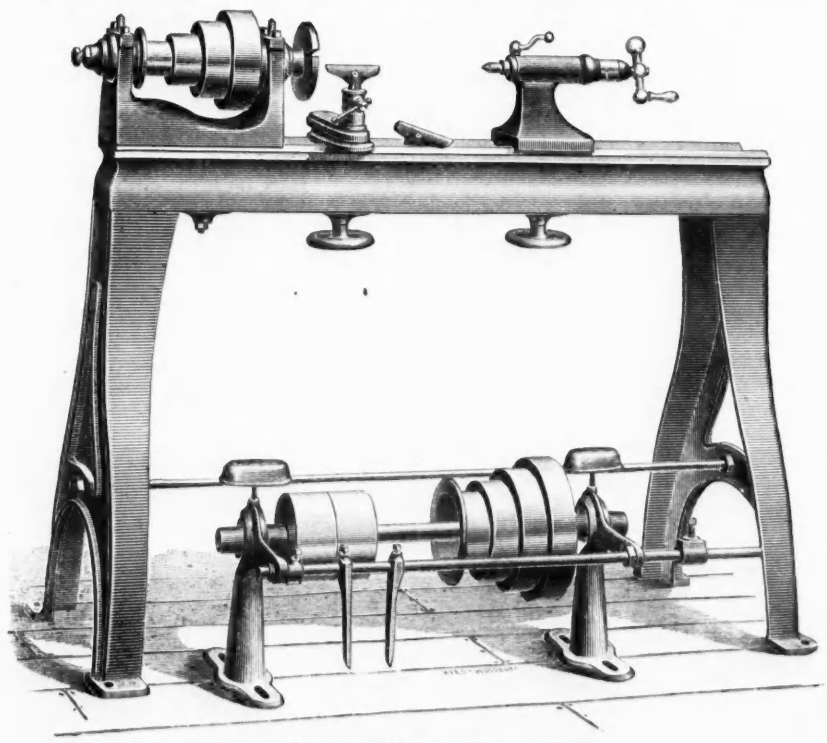
The machine is shown with the new vise made by the company; a different form of vise (known as the "old vise") is furnished if preferred. Countershaft and necessary wrenches are included with the machine. Directions for setting up the machine are on the inside of door on the base.



NEW FIFTEEN-INCH SHAPER.

Fairbanks' Hand Lathe.

This machine is built by Geo. L. Fairbanks, Worcester, Mass. It swings 11½ inches, and has a hollow spindle. The four-change cone takes a 1¾-inch belt. Handy clamping arrangements are provided for both tail stock and rest. It is a strong, well-built machine, provided with all arrangements for quick and handy operation. The same style lathe is built in different sizes as desired; countershaft and wrenches complete.



FAIRBANKS' HAND LATHE.

Western machine shop practice is well up in the use of a good class of ordinary machine tools, but decidedly lax in the use of milling and grinding machinery. As to that matter comparatively little use is made of milling and surface grinding machinery anywhere, but much more in Eastern than in Western shops. In most Western tool rooms the milling machine is unknown, while it is pretty certain to find a place in the tool rooms of Eastern shops.

Need of Patent Law Reform.

BY HENRY B. MORRIS.

Probably no large factor in the internal economy of this country is so little understood by the general public, and has received such inadequate consideration of late years by Congress, as the American patent law. Conceived in a most enlightened spirit, and with a far-seeing recognition of the approaching age of improvement, a provision for national legislation upon this great subject was imbedded in the fundamental constitution of the country, where it remains to this day undisturbed; and the successive Acts of Congress passed in accordance therewith have been more and more liberal to inventors, until the patriotic citizen points with natural pride to the splendid establishment at Washington, where an army of officials and clerks is now required to prepare and issue the weekly flood of certificates of American genius known as "patents."

Beyond all question, the patent laws were wisely conceived, and based upon theory and doctrine of the soundest kind. Nothing could be more consistent with public policy than that talented and ingenious men should be stimulated, by the hope of substantial reward, to multiply and improve the comforts and conveniences of life, and to enlarge the domain of useful knowledge. And it is not easy to see how a more equitable basis of reward could be found than that which has been adopted, namely, that he who benefits the public by a useful discovery should be granted a monopoly of the same for a limited time. If his invention be of great importance and largely used, the public obligation to him is great, and he will, presumably, receive large compensation, while for the production of a thing of little utility he will usually be poorly repaid. His remuneration, therefore, will generally be commensurate with his deserts, while the people at large lose nothing, being deprived of nothing ever before enjoyed. On the other hand, the civilized world is constantly receiving as a legacy the inventions of a few years ago, which are now becoming the common property of all.

All history, however, teaches that laws and practices, very wise and just at the beginning, or under certain conditions, may so far outlast their usefulness as to thwart, to a great extent, the object of their creation. This is especially true of all measures of political economy, which require an elastic adjustment to the needs of changing times. The patent law, originating, as it does, not in natural right, but in public policy, belongs to this class of enactments; and many signs seem to indicate that, in order to secure its greatest usefulness for the future, some changes in it are needed.

The first Act of Congress authorizing the issue of patents to inventors was passed in 1790. From that time until 1836 (when the Patent Office was destroyed by fire), embracing a period of forty-six years, 9,957 patents were granted, averaging about 216 per annum. On July 28, 1836, the present series of numbers of letters patent was begun, and a reference to the official record shows that at January 1st, 1853, the number 9,512 had been reached; the sixteen and a half intervening years thus producing nearly as many patented inventions as the first forty-six had done. The next five years brought forth as many more; and so rapid and prodigious has been the development, or perhaps the inflation of the system, that on January 1st, 1886, the whole number was 333,494: 63,674 patents having been issued during the last three years alone by the United States, every one awarding "the exclusive right to make, use and vend" something or other. The single year 1885 saw the conferring of 23,331 such "rights"—more than double the whole number granted during the first forty-six years, and more than 448 for each week. Surely, the inquiry may be fairly and pertinently made, Is this unexampled growth all a healthy one? May not the laws that originated the system, and shielded its infancy, need amendment to properly control its present gigantic strength?

After making the due allowance, and it is a large one, for the superiority of our inventive faculties over those of our ancestors, no cogitation over comparative statistics is needed to show that the increase of this interest has been, of late years, out of all proportion to the growth of the country. More than 100 times as many patents were issued in 1885 as in the average year of the first epoch, one-third of the whole number within the last six years, and two-thirds since 1872. Think of it!—200,000 patents in fifteen years, against less than one-sixtieth that number for a like

period at the beginning. Chief-Justice Marshall said, in Grant *v.* Raymond (6 Pet. 243), that "the great object and intention of the Patent Acts is to secure to the public the advantages to be derived from the discoveries of individuals." If this has been the full effect of the law, we are truly a favored people. But, since we are the supposed beneficiaries of this state of things, perhaps we may make bold to examine some of the workings of the present system, with the view of ascertaining whether the vast number of the blessings with which we are flooded affords a criterion of their actual worth.

Most people know that letters patent are granted for any invention possessing the features of novelty and utility upon an *ex-parte* and secret examination in the office. Almost anything, not positively injurious or immoral, is considered "useful," the law taking no note of the degree of its utility, so that very likely no greater care is bestowed in the office upon some great product of genius, like the telephone, than upon a clothes-pin or a toy. If this be not the case, then so much the worse for the toy trade, for the official reports of the Commissioner of Patents have for years constantly alleged and proved the utter inability of the office, with the force of examiners allowed, to cope with the colossal task put upon it. The fear is therefore well grounded that the prescribed examination of each case is often hurried and imperfect, and this fear is not allayed by following a few of these cases through another stage.

During the year 1884 there were reported from all the U. S. Courts, 75 actions in which the validity of a patent was at issue. Of these patents 34 were sustained, 32 declared void, and 9 adjudged to be partly valid and partly void; the cause of invalidity being, in most cases, want of novelty, and in many others improper grant of the letters. One might therefore conclude that about one half the patents issued are really void; but when it is remembered that suits of this nature are not often begun except where the interests at stake are large, and the plaintiff confident of success, a glance at the character of many of the patents will show that multitudes of them cover no invention worth the name; and that if any human tribunal could examine them all, very few (of the patents, I mean) would survive. At least two-thirds would without doubt be cancelled, were any serious defense made against them.

Within the last ten years, no less than 1,943 patents were issued upon that one simple device, a car-coupling. Of these 1,416 have appeared since 1880, and 279 last year. Leaving out rejected cases, this amounts to about five examinations each week of the 1,943 patents aforesaid, and of all their predecessors. Can such an investigation be fairly made, nearly every day? And is it possible that upon such a simple subject so many really patentable inventions can be had—more than the whole annual number of discoveries, in all branches, a few years ago? If so, one is lost in admiration, not so much at the fecundity of the inventors, as at the diligent ingenuity of the examiner, whose subtle mind can so quickly detect distinctions, not to say differences, among them all.

As time goes on, the difficulties in the way of a fair examination increase with the volume of the records to be searched; and as if still further to augment the danger of uncertainty and mistake, for several years past no models have been required, as formerly, by the office, the whole case resting upon a specification and drawing, which to the duller official perception of seven years ago was held to be insufficient to identify the invention. No reflection is here intended upon the efficient and faithful men in charge of this department of the government. They perform, as well as men can, the duties with which they are charged. But no argument is needed to convince any one of intelligence that a law whose actual effect is to work so much confusion and error, requires some modification, in the interest of all parties concerned.

For it has come to pass that the alleged inventor is often discouraged, and his success impeded, by the cloud of uncertainty resting upon the species of property which is his only capital, while he vainly attempts to secure financial aid in developing a franchise which the courts will, more likely than not, declare to have been void from the beginning. His only protector, the law, will quite probably prove his destroyer. This is so well understood by large numbers of ingenious men, that they avoid the Patent Office, and, when possible, resort to the antiquated but often more secure method of practising their arts in secret, for want of faith in any real protection that the law can afford them in return for the publication of their achievements.

But the public, for whose benefit, we are told, the existing plan was adopted, is the principal sufferer through this system of wholesale proclamations of rights of legal action, many of them ill defined, and the majority, as we have seen, having no real foundation in law, equity or otherwise. There exist, at this time, in full force, 260,000 unexpired patents, of which, all precedent shows, not more than half would be judicially sustained, leaving the other 130,000 to operate simply as a wrongful terror to manufacturers, every one of whom is familiar with the dread inspired by the discovery of an adverse patent, not in use, and to him before unknown. Moreover, the intention of the law, that the public shall receive a benefit, suffers defeat in about one-half the cases. The patentee may lock up his invention, however valuable to the people, who are thus utterly deprived of its use for many years. Nothing is more common than the custom of obtaining patents, not with any intention of putting them to practical use, but merely to prevent others from so doing. Clearly, this is contrary to the object of the law, as stated by the high authority before cited.

If the manufacturing interests of the country were small, the hardship of such a state of things might be inconsiderable. But it is a great evil, needing speedy redress, that the honest manufacturer should be in perpetual danger of legal prosecution, through his failure to search a record so large and complex that the experts of the Patent Office are themselves unable fully to do so.

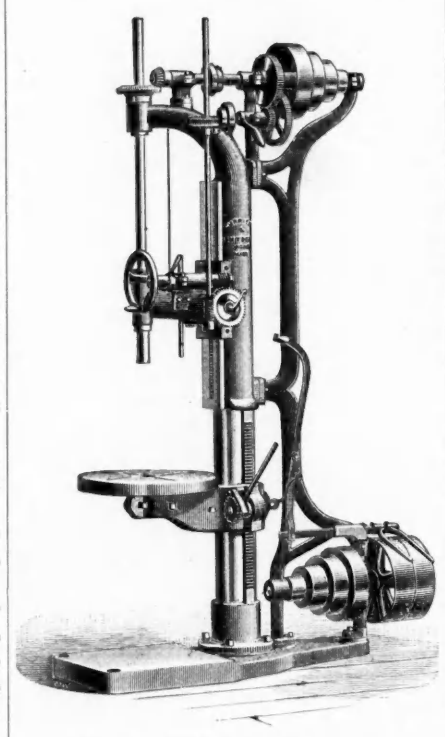
To point out an evil of this kind is far easier than to prescribe its cure. But some remedy must be found, and that soon, for the difficulties of the present system increase with time, in a progression almost geometrical, and great danger exists that before long—simply from the preposterous bulk of the record of patents, which grows steadily longer, like the story of "the house that Jack built," and from the uncertainty of any proceedings that can be had under it—the unwieldy mass may fall to pieces of its own weight. Common justice would seem to suggest that the public should henceforth exact from the privileged inventor a fair exchange, or some commutation therefor; and if such a requirement also operates to cut down the number of future patents to those possessing tangible value, so much the better for every one.

Let the Government adopt the method long in successful use in other countries, of stipulating for the periodical payment of a fee, say thirty dollars a year, to keep every future patent alive. Regular publication could be made of the rights forfeited by non-payment, and the manufacturing public thus informed of its safety from these sleeping enemies. Valuable inventions whose manufacture is prosecuted, can well afford this trifling tax, while the visionary experimenter will suffer no more than at present, since a short time usually suffices to convince him that he has produced, and is entitled to, nothing of real worth. Were this measure adopted, the number of applications would be quickly reduced to those concerning which there was at least some serious intention of business; and the grantee who cannot or will not truly benefit the public could not enjoy gratuitously the luxury of preventing a real manufacturer, his artisans and customers, from giving and receiving the good intended by the law. These have rights, not to be justly destroyed by the mere conception and record of an idea never reduced even to the form of a model.

Unwonted attention has been of late directed to the patent laws, and much adverse prejudice excited by the prosecution, whether rightfully or not, of thousands of suits under the famous "driven well" patent. The last Congress saw the introduction of no less than five bills to amend the existing acts, most of them exhibiting pure hostility to the whole system. An unreasoning spirit of enmity has arisen against the entire code of laws whose wisdom encouraged the genius of Whitney, McCormick, Blanchard and Morse, until it may be reasonably feared that all may be swept away, unless moderate correction shall anticipate the indiscriminate attacks of uninformed prejudice.

Tweuty-Inch Upright Drill.

The engraving herewith shows a 20-inch sliding-head upright drill, made from new patterns by Currier & Snyder, Worcester, Mass. It has a continuous wheel feed of 24 inches; also a lever which can be used for light drilling. A particular feature is that the head can be placed in any desired position upon the face of the column instantly. Head is fitted to column by hand scraping.



TWENTY-INCH UPRIGHT DRILL.

Cones have four changes of speed. Gears and racks are cut from the solid. The vertical movement of table is 18½ inches, and the greatest distance from spindle to base is 50 inches. The tool is substantially built, and adapted to a wide range of work.

Getting Out Stavework.

BY FRANK W. BARROWS.

Patterns for round pieces are made solid, when not too large, or if they are very irregular in outline. When the outline is nearly straight, with the exception of flanges, which may be put on, the patterns may be made to advantage by gluing up the stuff in staves. Probably every patternmaker has had some experience with stavework, either on pipes or cylinder patterns, and each one may have some ideas of his own on the subject, or he will if he takes the interest in his work that he should do to insure success. I don't mean to say that my way of putting up stavework is the best; still, it will compare very favorably, as regards time, with any way I have ever seen. And there may be nothing original in this one method, yet it will be new to some, and to these I will try to make it plain.

If your pattern isn't too large in diameter, say, 14″ or 16″, you can make the heads out of plank. For larger work a better job can be made by gluing up the head similar to cant or segment work, making them in half circles, closing the straight sides, or what will be the joint of pattern, by courses of the same thickness as cants, and lapped back and forth at the joint where they join the circle. You can also put in arms where the work is very large. These large heads should be jointed together in pairs and then laid out. They may be turned if you wish, and then, by working out the staves on the inside, to fit circle of head, as shown in Fig. 41, (page 3), you will do a first-class job. Another way is to space off the heads for as many staves as you want and then cut them off, so that the staves may be put on without any work on the inside, except what may be necessary to take them out of wind. For a big job I think this would take more time than to work the staves as in Fig. 41. Another point in favor of fitting them up as in Fig. 41 is, that the staves may be of almost any width and still come smooth on the inside surface of pattern. This will not be the case where the heads are cut into polygons; unless one is very particular to get all the sides the same length, and the inside width of staves the exact width of the sides of heads.

For small heads which are sawed out of plank, if you have a crosscut saw with an adjustable slide for cutting bevels, you can cut the heads for flat staves without any laying out. Joint off one edge of the pieces that are to form the head straight and square, set your slide to the angle *h i k*, Fig. 37, and saw all of the heads at one end; then put a stop on the sliding gauge, which will give the heads the right length, as from *s* to *i*, Fig. 37. Now, by putting the end *i*, which you have already cut to the angle *h i k*, against the stop, you may cut the heads to the length and also make the side *a* at the same angle with *s i*, as you have already made the side *g*.

Now, you must change the slide to the angle of broken line *h l k*, mark off on one of the sides, already cut, the length of side, as from *i* to *k*; then, by adjusting the stop on slide so that the saw will cut to this point, you can saw two more sides on each head, as *b* and *f*. Go through the same process for each succeeding pair of sides, until the angle at *l* becomes too small to work from the sliding gauge.

For the remaining sides cut a piece of board wedge-shaped, as in Fig. 38, and at an angle which will make the side *j l* parallel with the side of head you propose to cut, when the head is laid against the slide in position for cutting. Fasten a piece on this gauge at *n* to bring all of the heads to be sawed into the same position. Use the fence, which is parallel with saw, in connection with this gauge. In Fig. 37 the two sides *c* and *e* are to be cut by the help of gauge, shown in Fig. 38.

For any number of sides up to eighteen, I should saw all but the last three by the bevel gauge, and the next two by the fence and wedge. The last side *d* needs no gauge, as it is parallel with side *s i*. Don't throw away the gauge, Fig. 38, but mark the number of sides on head, bore a hole through it, and hang it up ready for the next job, having the same number of staves. The diameter of pipe or cylinder makes no difference with the angles.

You will find when you have finished the heads that they are more accurate than would have been the case, had you tried to lay them out before working. Also, if there is any irregularity in one, it will be repeated in each head, so that all the faces will come parallel. This, as you see, overcomes one difficulty in stave-work. You must keep your saw in good shape, for you can't do this job with a poor saw and make it satisfactory.

If you are going to close over the joint of your pattern, you must saw from the joint of heads the thickness of stuff, as shown by broken line *o*, Fig. 41, you will put into the joint. I don't think this is any improvement; in fact, I should rather leave the pattern open, and give it a good coat of paint inside to keep out the water. If it is closed up it will gather moisture inside, and then, when the pattern is laid away the outside will dry first. This will try the joints and probably start some of them. If you make up your mind to close over the joint, get out your stuff and fasten the heads to it in their right places, taking care to get them square with the axis of pattern and all on one straight line, else your staves won't fit. For an open pattern, fasten the heads on a flat board in

their places, keeping them square and all on a line, and setting the end heads out far enough to clean up in good shape when you turn up the piece.

I cut up the staves in this way: make a piece a couple of feet long, having a section like *r* in Fig. 39. Let *p* be a section of a stave; then make the piece *r* of such section as will make the angle *t y x*, formed by the combined sections of stave and piece *r*, a right angle. The width of this piece I should make not far from the width of stave. Put this piece on saw table between slitting saw and fence, with the thick edge towards saw. Now, having your stuff for staves cut up to the right length, the small cut shows a section of one of these pieces before splitting into staves. The lines 1, 2, 3, 4, show where it is to be sawed. Begin by sawing one stave from each piece a little wider than necessary. Then you must reset the fence. If the fence is made to tilt, set it to fit the bevel of stave. If you can't do this, get a piece to lay between fence and the bevel edge of stave; for, if you gauge the width of stave from long corner, they will vary in width with the thickness of stuff used. By setting the piece *r* with the thick edge towards the saw, and then tilting the fence to fit the bevel of stave, you gauge the width of the staves on the inside surface regardless of the thickness of stuff. And then by turning over your stuff every time you cut off a stave you can save time and material. You will also be able to cut the staves closer to the finished size, because you work from the inside of stave. This is the side to get to size, as the width of staves on the outside is regulated by their thickness. You may, in fact, with a keen saw and a good solid saw table, cut them to the exact width and angle. Perhaps, to be on the safe side, you had best cut them a little wide, then joint one edge of all the staves straight and to the right angle, and then you could cut the other edge on the saw, making them at the same time of the right width.

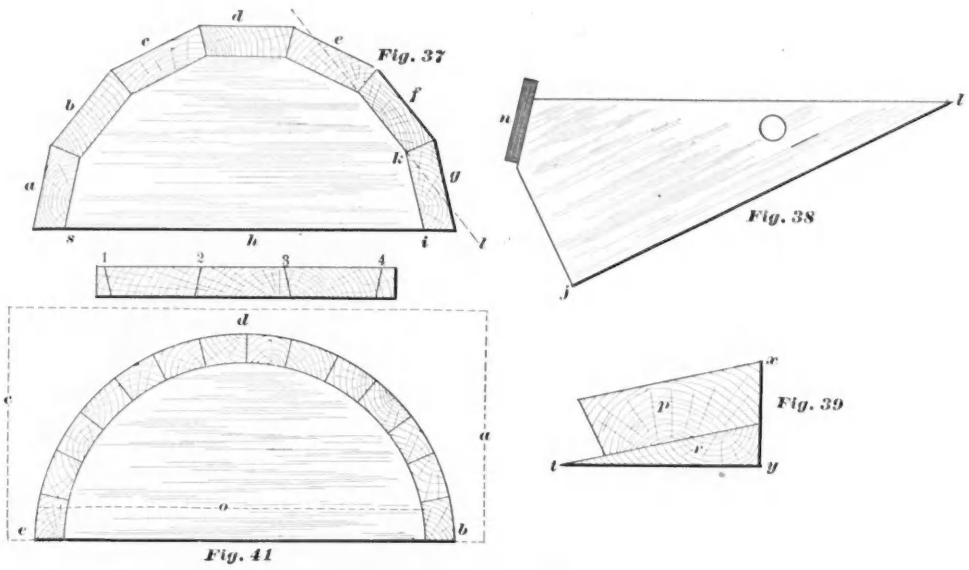
Mark piece *r* with the number of staves, and hang it up with the gauge, Fig. 38, for future use.

If you have made the heads like Fig. 37 put on stave *d* first, using screws, and counterboring for the heads so that the holes may be plugged. For heads like Fig. 41 you can begin at the joint, and if the joint is to be closed over begin on each side, putting in the top staves *d* last.

This will finish up one-half of the pattern; for the last half, if it is an open pattern, turn over the half already built up, and place the remaining heads, each on its mate, which has already been fastened into the first half, then begin putting on the staves as before. For a closed pattern each half may be built by itself, as it isn't necessary to have the heads match as closely as in an open pattern.

Core-boxes may also be made up of staves for a great many jobs. For these the heads will of course be on the outside. The usual way is to cut the heads out on a circle, allowing for the thickness of staves, then set them in position, and fit in the staves beginning in the bottom. A better way is to glue up the staves without any heads, then work out the inside of your box, cut it off to the right length making draft on the ends, then nail on a piece of stuff at each end, which will form the head and also the end of box as shown by broken line *b a c e*, Fig. 41. Now turn your box bottom side up and glue a block on inside of head under each stave.

Another and better way to put on the heads, after you have worked out your box, is to gauge the staves at the ends of box to a thickness from the inside. Then cut them to this thickness back an inch or two from the ends. Put the two pieces for ends of box in the lathe and turn a groove that the ends of staves will fit into, and also turn off the draft necessary to get out the core, then fasten them on the ends of box. Where the staves are put on in either of the last two ways it makes a stronger box than when the heads are cut out to fit around the outside of staves, for then you have a weak place at *b* and *e*. If you want any heads between the two ends they will have to be fitted around the outside of staves.



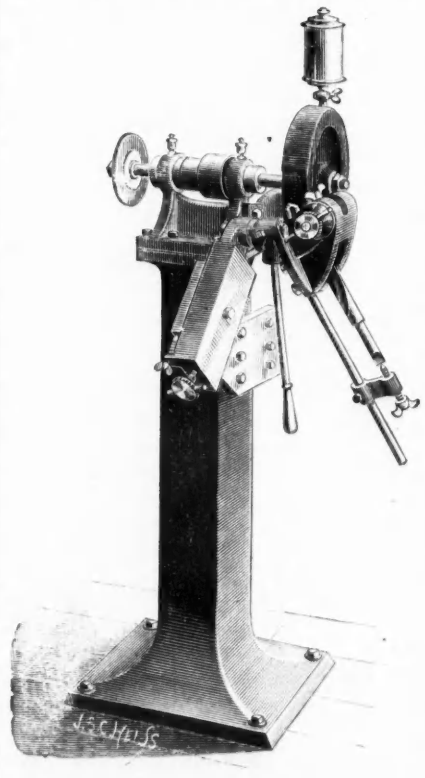
GETTING OUT STAVEWORK.

The Hough Twist Drill Grinder.

In this machine the drill to be ground is held in a specially-adapted, two-jawed chuck, operated by right and left-hand screw. The drill is held in line by a center, which traverses an arbor parallel with the axis of the drill. An adjustable gauge, set in contact with the lip, secures uniformity. The drill chuck is mounted on an arbor, which is connected to a slide worked by a screw.

Clearance is had by eccentric motion, different degrees of clearance being obtained by bringing the end of drill nearer to or farther away from the center of motion. Lever motion rotates the drill for grinding.

The slide previously mentioned is provided with a graduated gauge, which is particularly convenient in grinding a drill which has been broken in use. In this case the broken lip may be ground, the gauge position noted; then, in grinding the other lip, come up to



THE HOUGH TWIST DRILL GRINDER.

the same gauge mark, and the lips are of equal length. A small wheel is mounted on opposite end of arbor, which may be used for grinding out the groove at the lips of drill, or, if desirable, for other small work.

Manufactured by Warner & Hough Machine Company, St. Paul, Minn.

The new bridge over the Harlem River, in New York City, will cost $2,055,000. It will be built jointly by the Passaic Rolling Mill Company and Myles T. Tierney.

Firing Steam Boilers.

EXTRACTS FROM A LETTER WRITTEN BY DR. FREDERIC SIEMENS, OF DRESDEN, SAXONY, TO DR. GEO. H. BENJAMIN, OF THIS CITY.

There is a very simple way of firing, which answers very well, and which does not require complicated constructions and appliances, always more or less objectionable.

It depends upon the following considerations: When fresh coal is charged upon incandescent fuel, as is the case in the usual mode of firing boilers, the volatile gases of the fresh fuel are rapidly evolved, filling the fire-box to such an extent as to prevent the ingress of air through the grate, and this occurs at the very time the air supply should be considerably increased. The result is imperfect combustion and consequent waste of the very best combustible gases, viz., the hydro-carbons, which cannot burn for want of air to combine with; free carbon is thus liberated from these gases, and smoke is produced. In order to avoid smoke, and consequent loss of fuel, any sudden production of volatile gases, either during or after firing, must be prevented; and sufficient air should always be introduced, and so distributed, as to burn those gases as quickly as they are produced. This can be done in the following manner:

Before putting on fresh coal, the burning fuel should be pushed back from the front part of the grate, and distributed on the incandescent fuel behind, care being taken that this portion of the grate is entirely free from hot fuel. When the front part of the grate has become comparatively cool, owing to the cold air passing through it, fresh coal is distributed thereon. The freshly-charged fuel lying on the cool grate, with cold air passing through it, will be heated by radiation only, partly from the incandescent fuel behind, partly by the flame from its own gases, and partly by the surrounding hot brick-work. The volatile gases will consequently be liberated at a comparatively slow rate, and will combine with the air, which, entering through the interstices in the fuel on the cool part of the grate, will be evenly distributed over its surface.

Gas and air will thus be supplied in nearly the proper proportions for complete combustion of the fuel, and as the production of vol atile gases diminishes, the air passing through the front part of the grate will enter into combustion with the fuel thereon, which has been deprived of nearly all its volatile constituents.

By means of this simple method the sudden production of a large volume of volatile gases is avoided, and air in a well divided state is always present to consume the gases liberated; thus smokeless combustion and saving of fuel are realized. Care must be taken that the fresh fuel is charged at regular intervals of time and in equal quantities.

The present Congress seems to be a big fizzle. So far as tariff legislation or currency legislation were concerned it was evident long before the beginning of the session that nothing radical would be done. The letters from new members of Congress to the AMERICAN MACHINIST upon the tariff question, which we published a year ago last February, made it evident that a majority was opposed to breaking down protection. It was expected that a postal telegraph law would be passed, that unearned lands granted to railroads would be reclaimed for settlement, that some action would be taken upon Samuel J. Tilden's proposition to provide a much needed system of coast defenses, and that a bankruptcy bill would be passed. Instead of taking action upon these matters Congress has not even passed the necessary appropriation bills to continue navy yard and other Government work from the close of the fiscal year, June 30th. Bills involving large jobs have been pushed forward, like the addition to the river and harbor bill, beginning the expenditure of untold millions to dig a big ditch from Chicago to Rock Island, an enterprise of so little public value that private capital would not touch it.

How not to do it has been well exemplified in the first session of the 49th Congress.

Economy of Steam-Engine Regulation.

The following from the circular of a well-known firm of steam-engine builders is of general application, and expresses a fact not yet so well understood as it should be:

"In many industries a carefully-determined speed of machinery cannot be exceeded without material—sometimes very serious—loss; while, if the speed is slower, the production is correspondingly decreased, and frequently the product is inferior in quality. If the speed of a steam engine cannot be controlled within narrow limits, then the normal speed must, as a matter of course, be considerably slower than that at which the best results will obtain, in order that the maximum speed may not exceed the limit. When the regulation is close, the normal speed may be almost exactly the maximum, instead of several per cent. slower. In one case the machinery is kept in motion at a speed representing its greatest productive capacity, instead of, as in the other, several per cent. below this. A closely-regulated engine may readily increase the capacity of machinery from five to ten per cent. as compared with one in which the regulation is only moderately good—a matter of no small importance in large manufacturing interests."

The Western Furniture Manufacturers' Association holds a Convention in Cincinnati, beginning July 21st. They will discuss the labor question with much interest.

The *Railway Conductors' Monthly* credits, the following story to "Ex.:"

"A good story is told of an engineer on the Northern Railway. One night this spring he was bowling along through the swamp, the other side of New Lowell, with about twenty loaded wheat cars after him. The frogs in the adjacent swamp were singing louder than the roar of the flying car wheels. The night was pitch dark and foggy. Suddenly he heard what he took to be the sound of an approaching locomotive whistling at a crossing ahead of him. He reversed the engine, whistled "down brakes," and brought the train to a standstill. All on board listened intently for the sound of the coming train, but none could be heard. By and by the loud croak of a monster frog, in the marsh on the left, told the story of his deception. Now, all the boys have to do is to call out 'Frogs," and the driver feels worse than a new street car employe."

By a peculiar mistake the names under cuts on our first page last week were reversed in printing. The first should be "Cutting-off Machine," and the second "Valve Milling Machine."

The Purves Piston Packing.

This packing is the invention of Thomas B. Purves, master mechanic on the Boston and Albany Railroad, at Greenbush, N. Y

The accompanying engravings show the application of this packing to existing pistons; in new work there is some simplification of parts. Fig. 1 is a plan of the engine piston; Fig. 2, a section on line *x x*; Fig. 3, section on *y y*; and Fig. 4, a side elevation of the packing ring.

E is the inside ring, uncut or solid. In this instance the inside ring is made with projections, which are a close fit on the spider lugs, making the spider and ring practically solid. In the lower side of inside ring are two cavities, *g*; these cavities are formed to receive solid metal liners *F*, which are used to keep the piston in a central position in the cylinder. These liners are originally made to a thickness that will center the piston; then, as wear occurs, thin liners may be added.

The packing ring *G* is cut as shown at *c c*, Fig. 4, and supplied with a piece *H* to beak the joint.

This packing is of the balanced type. Of this the inventor says:

"The principle upon which the balancing or counterbalancing is effected, and the advantages thereof, are as follows: On the admission of steam against the piston, the outside ring thereof is carried tight against the spider or the follower, as the case may be. This movement of the ring allows the steam to pass inward over its open edge to the openings or space inside of it. This steam forces the ring out against the inside of the cylinder, making it tight. A portion of the steam at the same time passes through the holes to the outer grooves, where it comes in contact with the inner surface of the cylinder. Thus, the minute cells or pores of the rubbing surfaces are filled with steam, and the piston is continually moving over a thin stratum or film of nearly or quite the same density outside of the ring as it is inside, thus making it balanced."

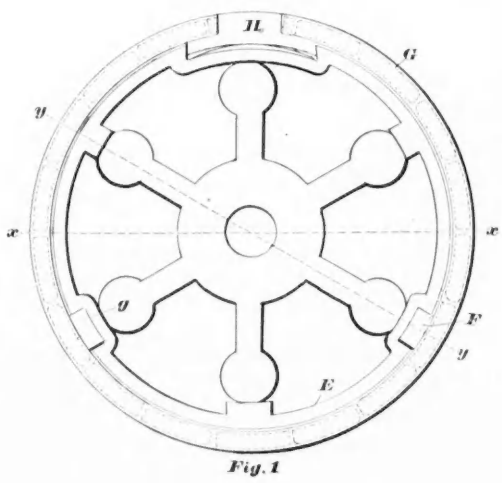


Fig. 1

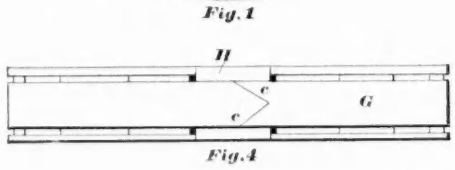


Fig. 4

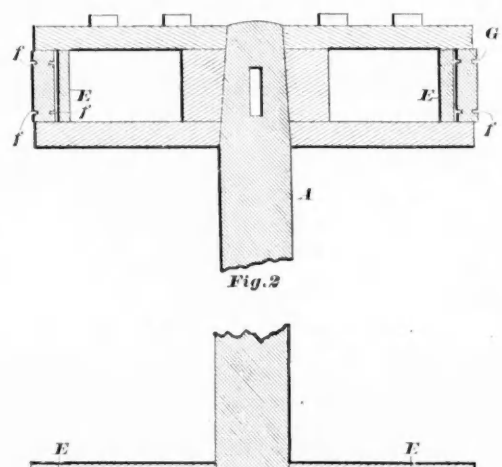


Fig. 2

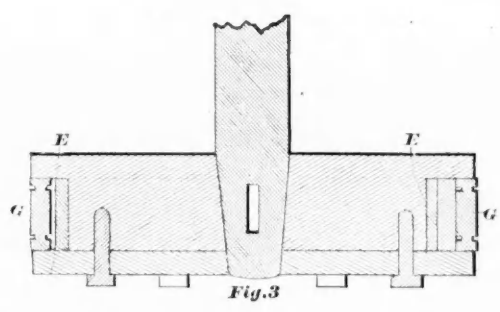


Fig. 3

PURVES PISTON PACKING.

Naphtha Engine.

The gas engine illustrated on page 3, AMERICAN MACHINIST, June 12, consists of three single-acting cylinders, 3¼" diameter, by about 4" stroke. The cylinders are coupled at 120°. The naphtha vapor is admitted and exhausted by three plain slide valves, one to each cylinder. These valves are connected direct by means of slotted crosshead movements, to a valve stem, which revolves in same direction and at same speed as the wheel shaft, to which the three pistons are coupled direct.

Naphtha vapor is generated in a double coil of gas pipe, which is wound around a central standpipe, which, together with the valve chest, forms the steam or vapor room of the generator. The coil is heated by naphtha vapor taken direct from the generator.

The valve chest is in direct connection with generator at all times. The induction ports are but about ½" long, and open perpendicularly into end of cylinder.

The eduction or exhaust ports open into the case enclosing crank-shaft, connecting-rods and cylinders.

The cylinders are cast in one piece with the plate which separates valve chamber and crank pit.

Starting, stopping and reversing is effected by means of a hand-wheel attached to rotary valve stem. The gear which drives valve stem is placed upon a loose sleeve, which is supported by the valve stem.

An internal gear is placed upon this bushing, and by means of a small pinion engages a gear upon the valve stem.

By turning the hand-wheel the pinion and valve stem are revolved until a stop is reached, which is so fixed that it engages the hand-wheel when the valves have obtained the maximum advance.

By turning hand-wheel in the opposite direction until a similar stop is reached, the engine is in position to run in the opposite direction.

The point of cut-off, or the operation of "hooking up," is performed by giving the hand-wheel more or less advance toward either of the above stops.

Reversing at full speed may be instantly effected by simply grasping the hand-wheel, and preventing its revolution until the opposite stop is engaged, when, the wheel being released, the engine runs in the opposite direction.

The engine is stopped by applying friction to the hand-wheel until it is rotated to a position half-way between the two stops, then, all ports being covered, the engine stops. Slow speed is obtained by giving the desired turn to hand-wheel, fixing it at a point between dead center and full advance.

This engine is condensing, the exhaust vapor of naphtha passing through keel pipes, thence back as liquid naphtha to tank in bow of boat.

But comparatively little heat is necessary to vaporize naphtha, and an engine using vapor of 30 gallons of naptha per hour will burn about one gallon in vaporizing the whole amount.

Writing on Foundry Practice.

BY ROBERT E. MASTERS.

Some of the simplest things that we can write on every-day foundry practice are new to many readers of this journal. It will scarcely be believed that I have received letters of inquiry from men who thought of starting a small foundry and doing a little casting in connection with their repair machine shop in small interior towns, asking the meaning of the terms "cope" "drag," "follow board," "sprues," which they have often seen in the columns of the AMERICAN MACHINIST. It would be a good plan, and one that would benefit a great many, if some young men who have a little literary talent would commence and write articles on plain foundry work.

Don't imagine that your hand-writing is not good enough, that you must be very elaborate in your expressions, and present something that no one else has ever made and very likely never has occasion to make. Commence "at the foot of the ladder, and work up," present your subject in plain language, use shop terms where it will convey your meaning better, and mention all the little details, so that it will be thoroughly understood.

Don't be afraid of being criticized. If anyone has a plan that he thinks is better than the one you offered, it is not necessary for him to speak slightingly of an article that has appeared before on the same subject and intersperse his article all through with a big I. The readers of the AMERICAN MACHINIST are an intelligent class of men, and if the second plan is an improvement on the first, they will be able to judge of that for themselves, and will give the writer due credit. In this way all will be benefited and no one's feelings hurt.

Moulding pulleys is a branch of the foundry business that is practiced more or less in nearly every foundry in the country, from the large, well-equipped shops in the cities to the small country jobbing shops. No matter how well prepared a foundry may be for this class of work, there is always something new turning up that puts a moulder to his wit's ends to fill the order. I was once connected with a foundry that was prepared to make pulleys, either from patterns or strikes, from 3" to 14' diameter and any size face, and yet there was scarcely a week that we did not have some change to make in a pattern, or get up a special rigging to fill orders for pulleys.

An article on moulding pulleys, in the AMERICAN MACHINIST of Nov. 15, 1884, by L. C. Jewett, has benefited me considerably, as we have moulded several pulleys on that plan since that article appeared. My next article will be the beginning of a series on moulding pulleys, some of which may be well known, some known but very little, and some original. To any reader who after reading an article thinks: "Pshaw! I knew that before," I will say: Please remember that the article was written for the benefit of those who did not know it before.

Arrangement of Steam Plants for Factories and Mills.

BY WILLIAM H. HOFFMAN.

The modern cotton and woolen mill is vastly superior in productive power to one of forty or fifty years ago. Steam was then in use in the Eastern mills, but in most cases as an auxiliary power. As the water courses began to fail, the non-condensing slide-valve throttling engine was introduced; then came the same type of engine in condensing form, and finally the automatic releasing valve-gear engine in condensing and non-condensing forms. The latter styles were in use in many mills as early as 1850, the valve-releasing attachment being in all cases directly connected to the governor.

These engines were mostly horizontal in design, though from 1850 to 1860 the beam engine was a favorite cotton mill motor. Slow in rotative speed, and with a long stroke to obtain what was then considered a fair piston speed—say, 350 feet per minute—these machines, constructed for driving mills requiring, say, 300 horse-power, were ponderous and expensive.

The foundations for a beam engine of the capacity just named usually cost from $1,000 to $1,200, and the engine complete would cost from $9,000 to $11,000, or about double the present price for an engine fitted with all modern improvements, constructed on the horizontal, or the vertical direct-acting plans.

It was a common occurrence thirty years ago to find large beam engines, fitted with cast-iron crankshafts, and the writer has removed several of these within the past seven years, and in three instances these shafts had failed, and had wrecked the engines in two of these cases.

When the condensing engine came to the front as a factory engine, there were in those days engineers and engine-builders who claimed that the saving in fuel would not reach half-way to the line laid down by established theory, and therefore would not warrant the extra expense in construction and bills for repairs. But these prophets were soon driven to the wall, not to remain there, however, for in a few years they "came up smiling," and predicted the utter failure of the compound engine in any form or service, and, of course, we all know that their discomfiture has been complete—even worse than their former one. These same prophets had already predicted disaster to any engineer who should brave their high and lofty opinions, and construct a triple expansion engine, when several new steamships appear fitted with the latter type of engine, and showing a net saving in fuel of fully 22 per cent. over good two-cylinder compound engines, doing the same work, and all conditions being the same except in steam pressure, the triple engine being supplied with steam at 150 lbs., while the two-cylinder compounds received steam at 100 lbs. per square inch. The old-style factory engine received its steam from old-style boilers, the majority of them being what is known as the plain cylinder type. The settings of these boilers received very little attention, and the chimneys much less, so that their evaporation rarely reached a figure above 4½ lbs. of water per pound of good coal. The well-known two flue cylindrical boiler was also in use then, and performed its work well; but as the "prophets" before-mentioned said it was dangerous, because its flues had to resist a collapsing pressure, it was some time in getting into favor with the millowners. However, as the evaporation of these boilers when well set was fully 6½ lbs., they were bound to have a place as a generator, and did have one, and held it, too, for many years. After the two-flue boiler came the internally-fired drop flue boiler—a very excellent one for pressures up to 75 lbs.; for, of course, the corrugated flue was then unknown. This boiler required very little in the way of a brick setting, and I have known them to evaporate 10 lbs. of water with a pound of coal, while their average evaporative duty was fully 9 lbs.

The next boiler to appear was the present favorite, the multitubular, in its various forms, and its uniform economical results have given it a strong hold on the engineering fraternity. The return tubular boiler is simple in construction, is set easily, steams well, and is very durable. Thirty years ago Mr. Daniel B. Martin, then chief engineer of the U. S. Navy, invented a marine water tube boiler that did good service, but it was not strictly a sectional one, and about five years later the writer made some of the first drawings of a water tube boiler for marine purposes that was the invention of the eminent patent attorney, Mr. E. N. Dickerson, of New York. In these boilers, the tubes were inclined like the present favorite water tube sectional boilers, and the tubes were surrounded by a rectangular water shell in which the grate bars were placed, making a large and effective fire-box and combustion chamber. For factory uses, however, these were little used, but soon after their appearance the several types of water tube sectional boilers were introduced into many mills, and gave excellent results as to economy and are still doing so.

Mill engineers are about equally divided in opinion, as to the two methods of arranging motors in factories, viz.: the centralized power, one large single or double connected engine; and the sectional system, where the power is divided among several single engines, each one driving its own department. Each of these systems has its good points, and therefore it is sometimes

difficult to decide on the one that will be best suited to the interests of the mill owner, though the central system in economy of fuel is far superior to the sectional one. As regards the boiler plants, however, there is less difference of opinions, as nearly all engineers agree that it is best to centralize the boiler power, and lead the steam connections to the motor or motors in their several localities.

Of course we find many mills provided with sectional boiler power, but this system is expensive in every way, in labor, fuel, and repairs. The plant for lighting by electricity, and the one for protection from fire, should be separated from all other powers, both as to boilers and engines, for I have known of several extensive establishments being destroyed by fire, that were fitted with the most improved fire apparatus, but this apparatus was placed inside the mill, and could not be reached on account of the flames.

A mechanical engineer in Lynn, Mass., writes:

"I have been a constant reader of your paper nearly from its beginning and could not enumerate the help it has furnished me, yet I have frequently remarked to myself, why take up the space with such familiar and widely known methods? which wrong attitude has prevented me from writing many times before.

"I am prompted to write this because of a visit to one of our best machine works a few days since, and witnessing there the futile efforts to do some difficult work, or what would no doubt be so called.

"I had known a ready method years ago, and I am quite sure that the requirements were shown up very plainly in the AMERICAN MACHINIST previous to this, although applied to other work, yet it should suggest the remedy in this case, if read carefully. I suggested the remedy. The superintendent had but little faith in it, but I was very positive. One week after I called and that gentleman would attend to nothing else until I had seen the superior work done, after this simple and inexpensive change.

"I would explain right here the nature of the work, but I should be telling tales out of school, for they read your paper, though evidently they do not always read carefully."

The Chicago, Burlington & Northern Railroad, which is controlled by the Chicago, Burlington & Quincy, is finishing its tracks and terminal arrangements at St. Paul, Minn. It will erect new shops at La Crosse, Wis., as follows: A planing mill, 60x200 feet; a paint shop and two car shops, each 90x290; a blacksmith car depot, 60x100; another car depot, 60x100; copper shop and brass foundry, 30x60; boiler shop, 75x90; blacksmith shop, 75x200; machine shop 110x290; boiler and engine rooms, 40x50; coal chutes, with 84 bins, and woodsheds and transfer tables connecting. It is expected that the road will be completed to St. Paul early next fall.

There is a shop a few doors from the Inns of Court Hotel lighted by arc lamps. A man went to look into the window of the shop and was suddenly knocked down by some unseen agent; a policeman thereupon went to complain to the manager inside, but he was knocked over likewise. The reason of all the mischief was that the whole of the framing of the shop was of metal, also the area frame in front, and one of the arc lamp leads had somehow become connected with the framing. *Electrical Review.*

Printing Frame, and Manner of Making Blue Prints.

BY C. L. REDFIELD.

The printing frame may be a very simple and cheap affair if there are not many prints to take and their size is small. The writer made one that consisted of a board with three or four thicknesses of cotton flannel tacked to it, and a piece of plate glass held to the board by four common spring clothes pins. The whole thing was only about 12"x16". A much more elaborate frame, and about as good a one as can be made, is shown in Figs. 5 and 6. The frame itself consists of an upper and lower half, hinged together at the back and held together by two hooks and staples at the front. The upper half, which holds the glass, is provided with an eye-bolt or hook in the front edge, to which an overhead rope, running over sheaves and provided with a counter-weight, can be attached for the purpose of raising it. The cushion in the lower half, on which the glass rests, is made of two thicknesses of good soft blanket. Each end of the lower half of the frame is provided with a trunnion working in an adjustable clamp-box. These boxes are carried on two uprights from a base, which turns on a king-bolt on a truck below. The track should be laid on timbers cut through the window-sill and braced back to the building. The frame can tip forward at any angle to catch the sun, but is prevented from tipping back when opening it by the timber running across near the top of the uprights. Two pieces of iron fastened to the truck should project downward, and by a right angle bend into a groove in the timbers supporting the track for the purpose of avoiding derailment by wind or accident.

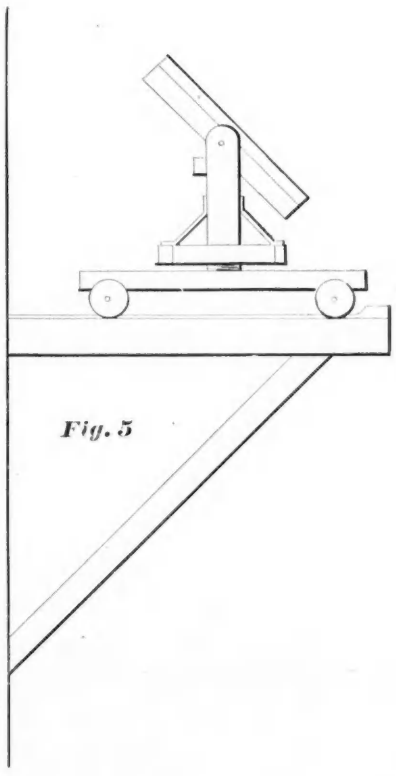


Fig. 5

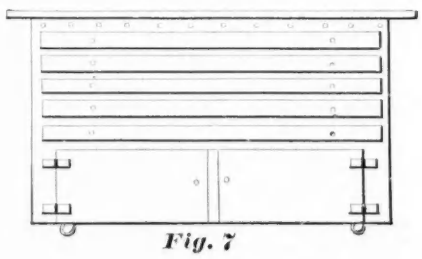


Fig. 7

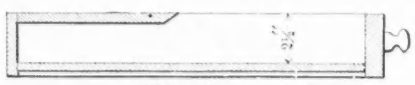


Fig. 8

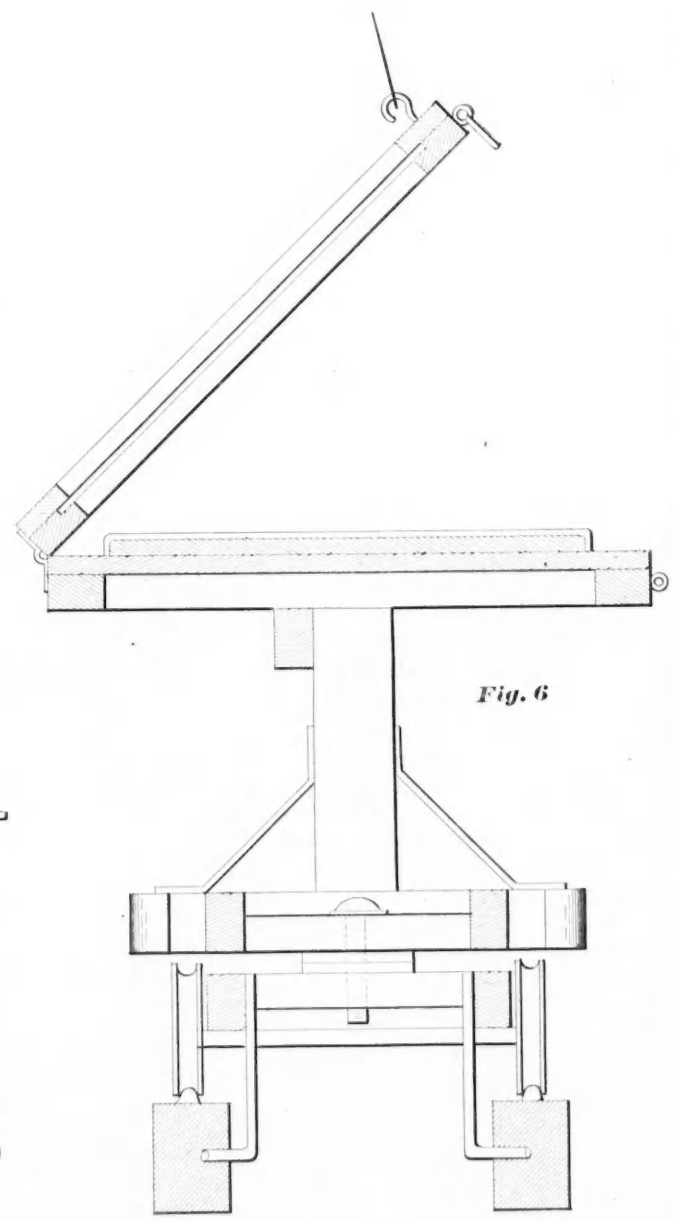


Fig. 6

The case for drying and preserving the prepared paper is shown in Fig. 7. In general design it is similar to the one for holding drawings. The drawers should have slat bottoms with $\frac{1}{4}$" spaces. The slats should run from front to back, and not crossways. The drawers should be large enough to hold the largest sheets that will be prepared, and should be about $1\frac{1}{2}$" deep. The cupboard in the lower part of the case is used to keep chemicals and other articles in. The bottom of the cupboard should be raised up about $1\frac{1}{2}$" above the bottom of the case, like the proverbial berry box, and should have a lot of $\frac{1}{2}$" holes bored through it. A row of $\frac{3}{8}$" holes should also be bored around the edge close under the top board.

The chemicals consist of soluble citrate of iron and red prussiate of potash. These may be used in any proportions, from equal parts by weight to five times as much citrate of iron as of red prussiate of potash. The formula that I use, and which is as good as any, is to pulverize $1\frac{1}{4}$ oz. of red prussiate of potash and dissolve it in a half pint of water. In another dish dissolve $1\frac{3}{4}$ oz. of citrate of iron in another half pint of water. When dissolving the citrate of iron, it should be stirred constantly, else it will become a sticky and unmanageable mass. The chemicals may be kept separate for an indefinite length of time, without being affected by the light; but after mixing them, they must be protected from the light, either by keeping in an opaque bottle or one rolled up securely in paper. An old stone ink bottle serves the purpose very well.

The paper on which the prints are made may be the same as used in the drawing room for pencil drawings. Watman's Linen Record is very good, but is rather expensive. Kennesaw, Germanic or some similar paper will do just as well, and cost only one-half as much. Special heliographic paper is a delusion and a snare. It is a very good scheme for manufacturers to get about three prices for a paper that is only about one-half as good.

When preparing the paper, a number of sheets should be tacked to a board by brads in the corners. The chemicals should be applied as evenly as possible by a good, thick brush. Prepared paper should present a light lemon color. Citrate of iron that gives a green color to the paper hould not be tolerated.

The exposure required to make prints varies from five minutes on a bright day to several hours on a cloudy or rainy day. A little experience will enable any one to tell by the color of the margin, which should be between a cast-iron and a stone gray, when the print is finished.

It is sometimes desirable to make a print with some of the dimensions or the name left off. It is just as easy to "stop off" a part of a drawing in the print as it is to stop off a casting in the sand. All that is necessary is to cut out a piece of blotting paper or a piece of tracing cloth, inked over, of the size of the required stop off, and put it over the drawing, and the result is a white spot on the print.

A bottle of liquid should always be kept for the purpose of writing in white on a blue print. If you wish to be mysterious about it, you can mark it with a skull and crossbones, and tell any inquisitive person that it is a mixture of bi-carbonate of soda and hydrogen oxide, and there won't be one person in twenty who will mistrust what it is; but if you wish to explain it to any one, you may say that you worked your way out into the kitchen the other day and begged a teaspoonful of baking soda from the cook and put it in some water.

When the same drawing is intended to be used a number of times in the shop, the blue prints should be mounted on cardboard, and given several coats of white shellac, after which they may be kept on edge in racks, suitably designed and partitioned off for the purpose.

What One Young Man is Doing.

A young man, now living in Philadelphia, and working at architectural steam fitting, desires to become a practical steam engineer, capable of establishing and managing steam plants in factories and mills.

Advice being asked by this young man, he was advised to connect himself with the Franklyn Institute and read up, from their library, the subject of steam engineering, and at the same time work at his trade until theoretically qualified to obtain work in erecting mechanical steam plants.

In following the above course, an unexpected obstacle was encountered. The student's knowledge of mathematics proved so limited that he could not understand the books which he desired to study.

The man proved equal to the occasion. He bought an arithmetic, secured the help of a high-school graduate friend, and is determined to conquer arithmetic and algebra.

The course taken by this young man, who he states "helps his mother" while he is studying steam engineering, is one that is open to all.

It proves that any man who wants to learn, and who is not too lazy, can fit himself for any position which he may desire.

A suggestion might also be conveyed to some men who are unable to understand valuable articles relating to their trade, simply because the matter in question contains an algebraic expression or a mathematical demonstration which they are unable to comprehend.

Such articles are always disparaged by this class of readers, and oftentimes justly, but would it not appear rather more like a live mechanic, if when such difficulties are encountered, the reader would set to work to educate himself so as to be able to understand them?

The young man above alluded to, rightly takes the stand that the unknown mathemat-

ical expressions contain knowledge of benefit to him, whereupon he sets at work to educate himself to the point where he may benefit thereby. He is right. By persevering he will succeed, and so will all who do likewise.

LETTERS FROM PRACTICAL MEN.

Making a Cast Iron Sheave.

Editor American Machinist:

I send you herewith sketches of a cast-iron sheave, representing the style of some large ones we have been making here at the M. C. Bullock Iron Company, Chicago. They had wrought iron arms cast in and spreading from each side forming good stays for the ring sideways.

The way I adopted to make these sheaves may be of interest to some of your readers. The groove and cope side of ring are formed by cores made in segments as shown in Fig. 1, while a pattern of segment like section in Fig. 2 forms the bottom of mould and also a seat for the cores. It is best to make the groove and cope cores separately at *A*, but the core box forming the two had better be made in one.

To make the cores separately, fit a block in core base at *A*, then make the cope cores. For the groove cores take block out and make a strike to sweep down to *A*. The stock for turning the groove should be allowed, so as to preserve the round edge as shown in Fig. 1.

Fig. 3 readily shows that the hub is also made with cores; after the core *B* is placed down over pin *C* the ring is moulded, segment pattern Fig. 2 being swung around from pin *C*; after which the groove cores may be set around and half number of arms in those seats which run toward the part of hub core that is already located. Pull the pin out and set in center core, then paste the two middle pieces of hub cores *F G* and drop over the arms set in, and you will then be ready to place in remaining arms, after which drop on cope cores of hub and ring.

Minor points that are so well known to the trade need not be mentioned.

P. S. DINGEY.

Chicago.

The Efficiency of Gear Teeth.

Editor American Machinist:

Mr. C. A. Smith makes a call in your issue of May 1st for more information on the subject of the efficiency of gear teeth, as presented for discussion in your issue of Dec. 26.

He seems to be having a hard time with my equations, and I will suggest that the subject will come easier to him if he will follow the advice he gives me in your issue of January 16th, and apply a little "polishing powder to personal arithmetic. His "personal arithmetic," or rather his algebra, is in an unfinished condition, and needs a little polishing before it is again exposed in public.

I regret to hear that Mr. Smith will not undertake to defend the epicycloid, for I am in search of some one who will come out in print in favor of that old-fashioned idea, and give the public something stronger than personal opinion, experience, and pugnacity. I can find many who prefer the epicycloid to the involute, but not one who is willing to come out squarely with any sort of a demonstration to back up his opinion.

Some time ago I was in search of a lathe, and applied at several of the Worcester shops where they are made, improving the opportunity to test the popular standing of the two forms of gear teeth. In one shop the conversation was about as follows: "I see you use the epicycloid, why do you prefer it?" "Because it runs so much easier and takes so much less power than the involute." In the next shop the conversation was about as follows: "I see you use the involute, why do you prefer it?" "Because it runs so much easier, and takes so much less power than the epicycloid." And so it goes; every man, when cornered, has to admit that he uses one form or the other, because he happened to use it first.

Mr. Smith divides the subject into five separate heads, and I will follow his numbering to save constant reference to his letter.

1. The "work done," in applied mechanics, is the product of the resistance overcome by a body in motion, multiplied by the distance through which the resistance is overcome. Force is not work, but, by moving through a distance, it produces work. In this particular case the angle of obliquity continually increases as the centers are separated, but at the same time the distance through which the teeth rub on each other continually decreases, so that the work remains uniform. Equation (2) is correct, and if it is not there is some error in the process by which it was obtained, which has not yet been pointed out. If the result is wrong, the process is wrong.

The neatest and plainest way to prove equation (2) is to make drawings at several different normal angles. The results will be uniform, and the same in amount as given by the equation.

2. I must congratulate Mr. Smith, for his position would be lonesome indeed, if, after

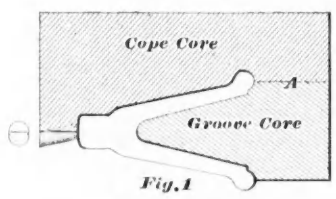


Fig. 1

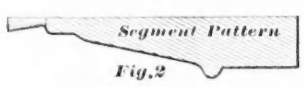


Fig. 2

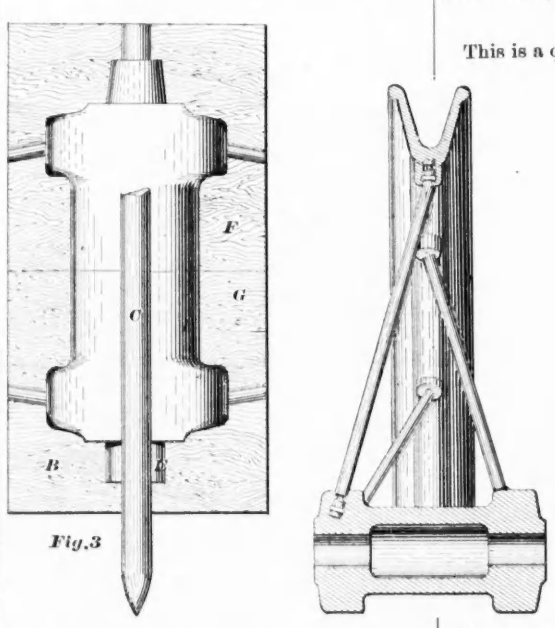


Fig. 3

such a tremendous effort, he had not discovered some small flaw in my work. My blunder was in the use of "center distance" instead of "normal angle," and was an error in interpretation rather than in analysis. Equation (2) is correct, and the error in translating its meaning does not affect it or its application to the subject of efficiency. The blunder is so very plain that it must have been an inadvertance which was not discovered because of the very small consequence of the result.

3. Here is a fine chance for Mr. Smith to apply a little of that polishing powder. He very quickly and correctly disposes of one s in the equation, but does not tell us what to do with the other. The letter s occurs twice in the equation, and any substitution must affect them both.

When s is put equal to infinity in equation (6), it becomes "indeterminate," for one factor then becomes zero and the other infinity, and $0\infty = \frac{0}{0}$ is indeterminate. If the regular differential process for the evaluation of indeterminate quantities be applied to this case, the true value will be found to be unity. The same result will be found by substituting different values of s. The higher the value of s that is chosen, the nearer will be the result to unity.

4. I fail to catch the meaning here, unless it is that Mr. Smith has confounded the angle M with the angle $\frac{180^\circ}{s}$. The two angles are entirely different, one being the normal angle and the other the half-tooth angle. The letter s is used to indicate the number of teeth in the base gear, and has no connection with the normal angle.

5. The half-tooth arc of action was chosen for two good reasons. The principal reason is that we must choose some definite angle if we wish to arrive at a definite result. A half-tooth arc is the least possible arc of action, and it is taken on one side only of the line of centers because the action is the same on the two sides, and it would be a simple repetition to use both sides. To use the whole arc is to introduce a quantity that varies with each case, and which is not the same, in the same case, for both the involute and the epicycloid.

The other reason is that I did not wish to be too hard on the poor epicycloid, and I should be only too willing to have the comparison made for some larger arc, or for the whole arc of action, as Mr. Smith proposes. We cannot choose less than a half-tooth arc, for there is never less than that, and to chose more is to give the advantage still more to the involute. Mr. Smith insinuates that I choose the part rather than the whole arc of action, so as to favor the involute as much as possible, but, if you take more than the least possible arc of action, the minute advantage of the involute is changed to a very decided advantage. The position I took was purposely the least favorable to the involute. I am willing to give the epicycloid all the room there is to be had, for it needs it all if it is to maintain the reputation it has in certain quarters, but, if its friends insist on the whole arc in this case, I have no objection to offer.

JOURNAL FRICTION.

This is a question that I have not attempted to analyze, and my reason for supposing that the two curves will give practically the same results is that they give exactly the same result at the half-tooth point. The comparison of the two curves can be made only by means of the calculus, and no amount of algebra or of common sense can settle the question. It is not a question of angle of obliquity, or of common sense, but a simple question of work done by friction, and that curve is the best which gives the least integration for the work done for some given arc of action. Whether the half-tooth arc, or some larger arc, is chosen, the results will agree within a minute fraction.

Mr. Smith is too fond of what he calls "common sense." Common sense might be of first importance in a horse trade, but it has less application in a question of mathematics. The elements of algebra would serve his purpose much better.

The real test of any question in practical mechanics lies in actual experiment, and not in analysis. But experiments in this direction have all proved abortive, and I think that my reasoning shows the cause to be that the real difference is too minute to be developed by any such method.

THE REAL QUESTION.

My main purpose has been to show, not that the involute is the most efficient tooth curve, but to dispute the too common opinion that it is much inferior to the epicycloid in point of economy. The involute is really a very little the most economical, but the difference is so small that the real question of superiority is left open to be decided by other considerations, where it has undoubted advantages.

"The common opinion among millwrights and the mechanical public in general, in favor of the epicycloid, is a prejudice that is founded on long-continued custom, and not on an intimate knowledge of the properties of that curve."

I hope Mr. Smith will not be discouraged at the slim results of his mathematical criticism, but will try again and take a smoother road next time. No one should question a mathematical result who is not able to follow the analysis by which it was obtained, and no one should attempt to polish another's "personal arithmetic" until his own is in presentable condition, for "it is a poor rule that will not work both ways."

GEORGE B. GRANT.

Boston, Mass.

Report of Master Mechanics Committee on Driving Wheel Brakes.

This committee, consisting of H. Wallis, G. T. Ry.; F. W. Wells, S. & N. W. Ry.; T. M. Wordsdell, N. E. Ry., made a long and exhaustive report, from which we extract as follows:

In answer to committee's query "should brakes be applied to the wheels of all engines?" 19 said yes, on all drivers; 3 would like to restrict them to freight or switches; and 2 are more or less opposed to their application, a few saying they have no experience or know of no satisfactory brake. Of these replies (to the disgrace of our lazy members be it said) 8 were from engineers not members of this association, but representing an experience with many thousand engines, and if the replies in general be not treated numerically, but considered as the casting of votes equivalent to engines represented, they show an overwhelming majority in favor of the application of brakes on all engines.

Granting, then, by reason of modern high speeds and density of business, the traffic necessity for driver-brakes, what are the points that discourage their application? Do they increase the cost of working by lessening tire mileage? Of replies received 11 say yes, or think so; 2 say do not know, or think not; and 8 say definitely they do not; a few of the latter going so far as to say that if the proper form of shoe is used, so as to bear upon that portion of tire tread and flange not worn by rail, an increased mileage can be obtained.

Do driver-brakes lessen engine mileage between repairs? 4 reply yes, or think so; 11 no, not much, or think not; 11 report a tendency to fracture axle, boxes, etc.; 4 say yes if wedge type, but not if compression type is used or pressure is equalized; and 5 ignore the query.

On the general question as to the coupling up of the brake-gear throughout the whole train, its automatic action on drivers, or whether it is advisable to allow a conductor to apply brakes on drivers, opinions vary much.

Mr. Aspinwall said, any form of automatic continuous brake should be capable of being applied by the conductor on all vehicles as well as by engineer.

Mr. Ely—In a general way I should say, that as the traffic on our principal railways, and the speed at which trains are run, has so greatly increased as to require extraordinary facilities for controlling the movement of trains, and as these facilities are, as far as we know, limited to the weight of the equipment, the retarding force should be applied to all available parts of the train.

To the somewhat crude question of what percentage of weight on drivers should be utilized? One reply says 7 to 10 per cent.; another 45 per cent. on engine and tender, with 100 per cent. on cars; a third 50 to 60 per cent.; a fourth, 80 per cent.; a fifth, 75 to 90 per cent; a sixth, 95 per cent.; and a seventh, says twice the weight on drivers, or 200 per cent.

In the matter of brake-block shoes, their substance, size and shape, 6 are in favor of cast-iron, and 7 of wrought iron.

Mr. Webb says: The best results we obtain from wood blocks, when they can be conveniently applied. Those we have in ordinary use are of English poplar, about $18'' \times 2\frac{1}{2}''$, the face is perforated with $1\frac{1}{8}''$ holes, which are afterwards filled with a mixture of rosin and sand, and Mr. Johann, while preferring wrought iron, has obtained excellent results from a head filled with hard wood blocks.

DISCUSSION.

The President—The general sentiment of the replies which the committee has received from parties to whom they had addressed enquiries was that driver-brakes ought to be applied on as many wheels as possible, and that there is no danger in the hands of any reasonable engineman in their daily use.

Mr. H. A. Whitney—I would like to ask what the experience was in regard to the wear of the axle boxes. Our experience has not been altogether satisfactory.

Mr. Lauder—While I cannot gives any reliable data to answer the question which Mr. Whitney has asked, for or against, there is one question which I think should be discussed a little and thought about; and that is in applying driver brakes to passenger engines, whether they should be applied for use in making all ordinary stops, whether they should be applied at all times that the brakes are applied to the rest of the train, or whether they should be held as an auxiliary or safety appliance; so that in case of an emergency, you have got something beyond

as an emergency brake. I am aware that the roads in this country are divided on that question. Some believe that the drivers should be made to do their proportion of the braking or stopping of a train whenever the train is stopped. That, from one standpoint, is all right. But, when you do that, you have nothing in the way of an auxiliary brake; you have no reserve power to use in case of an emergency. Whereas, if the driver brake is separated from the automatic train brake, and is only used in an emergency, you always have a reserve power, to be used in case of an emergency. If a driver-brake is used to make the ordinary stops, engineers will soon learn that they can make a stop a little quicker than they can without it; consequently the full braking power that he has under his control is at all times used. In case he finds he is running by a station, he is using all the braking power he has got in making that stop; or if he is likely to drop off—the switch may be wrong—or to have a collision with an approaching train or car that may be in the way; or in case of any of these things happening, or things of that nature, he is then using all the power he has got in making his ordinary stop, and inevitably he will do damage that might be avoided if he had a little reserve power back to meet just this emergency. My own practice is, to use the driver-brake on passenger trains as an emergency brake. It was formerly used on the old Colony road as an ordinary brake, but I have changed it, and now use it simply as an emergency brake. I have done that, because I believed that it was a proper thing to do on passenger trains. We are equipping all our engines, both freight and passenger, with driver-brakes as far as possible. Of course the brake is used at the discretion of the engineer. The majority of brakes I suppose, to-day, are simply wedge brakes between the driving wheels. This has a tendency to press the driving wheels apart, and possibly to cause extraordinary friction or wear on the axle boxes. Whether it does or does not I am not able to say from my own experience.

Mr. Ball—On the elevated road you are aware that they make a great many stops. Our engines are all equipped with the Eames vacuum brake. The driver-brake is an independent brake which can be applied at a moment's notice. Before I took the road, the engineers were accustomed to use the driver-brake for ordinary purposes. The result of that was that, with thirty engines, I have got twenty-six broken axle boxes now because of the use of these brakes. I myself broke two axle boxes applying the driver-brake. Since then we have abolished the use of the driver-brake, except in case of an emergency. We think it is cheaper to keep up a good brake than to keep up the motive power. It has a tendency to wear the driving boxes and to press the wheels apart. I think the driver-brake is a good thing on engines, and it has saved us a good many accidents.

Mr. Johann—I have some driver-brakes in use, but I beg to differ with Mr. Lauder and the other gentlemen on the use of the driver-brake. I believe it is a good thing; I think it is a good thing to be used at all times; and, in fact, in what experience I have had with them, I have met with no such difficulties as those of which these gentlemen have spoken. The first driver-brake that I had in use I put on in 1874 as a matter of experiment, and that ran along without any trouble, and was used to make every stop, the same as the train brake. I paid more attention to that train than I had subsequently; and the fact is that the tire of that engine wore better than those of passenger engines which did not have a driver-brake. In regard to the difficulty concerning which some of the members complained so much of, the effect on the box rods and so on, I can only say that I have never experienced any such difficulty. That engine went along, and we had no more difficulty with the side rods and driving-boxes than with any other engine. I think that a good driver-brake is just what we want in addition to our train brake, and that it should be used in connection with the train brake; and if an engineer will handle the brake properly, he does not necessarily have to apply it so severely as he does if he does not use it at all times. I think it should be used at all times. I think it is a good thing, and that all locomotives ought to have it.

Mr. H. A. Whitney. We use the driver-brake to make every stop. What is the object of a brake? What is it there for anyway? It is to arrest the progress of the train. Because a man uses a brake at every stop it don't prevent his using it in an emergency. If he uses it judiciously I cannot see the objection to his using it all the time. If you have a short, light train then you want to put the driver-brake on suddenly; but on a long, heavy train the weight of the train is so much more than the weight of the engine that it does not affect the train so much.

Mr. D. O. Shaver—I think that the brake should be applied to the drivers as well as to the train, and should be used in making all stops. We use it in that way on all our engines, and I do not see any trouble. It is said they wear out. They used to wear out when they didn't have any brakes on them. I do not see that they wear out any faster now than they did then. A brake, in my opinion, is no ornament to an engine; it is put on there to use, and a company can afford to pay for brake power.

Mr. Sinclair—My impression is, from very close observation of its action, that the brake shoes have a tendency to prevent the tires from forming an outside flange, but that the brakes are hard on driving-box brasses and on side-rod brasses. I think that if the driving-brake was applied so that it would take hold of each wheel independently, it might be used without any of that action on the axle-boxes and side-rod brasses. The experience which Mr. Ball had on the elevated road indicates in a very strong way what happens on a surface road in a smaller way. We do not have the experience of breaking the axle-boxes, because they are so strong that they will stand the strain, but the wear is there.

Mr. Ball—I think it has some relation to the way that this brake is applied. Our brakes spread the wheels apart. Apply that brake suddenly and you throw a blow of about 1,200 pounds on each wheel. I contend that that 4,800 pounds pressing on the boxes would throw the wheels apart. I hold that this would apply on a large engine the same as on a small engine. It shows that it is detrimental, or the boxes would not break and the brasses wear as rapidly as they do. If the brake can be applied on each side of the wheel, so as to hold the engine in position, I do not think it would injure your driving-boxes or your side brasses. On the Brooklyn Bridge Railroad the brakes are applied on both sides of the wheel, and on about a line with the center of the driving-wheel. On our class of engines it is almost impossible to equip them in that way. Speaking about the driving-brake being used continually, or in case of emergency, I contend that where any engineer has a brake on his engine that he uses continuously, with all his stopping of trains, in case of an emergency he is lost. We had a case on our road where an engine was rounding a curve, and if the engineer had been in the habit of using the driver-brake continuously he would have run into the rear end of another train; but he applied his engine brake or his driver-brake, and stopped his train. We have seen a great many cases of that kind.

Mr. Johann—The question is, is the driver-brake desirable to have? On that question, it is my experience that it is, and that it is desirable to use it at all times. Of course, if this gentleman has a peculiar road that requires extraordinary arrangements, he is at perfect liberty to have those extraordinary arrangements. So far as I am concerned, I say that the driver-brake is a good thing.

Mr. Ball—I do not say that the driver-brake is not a good thing. I would not have an engine on our road without it. But I say it should be an independent brake to be used in case of an emergency; and I say there should be some way of cutting it off. With the automatic arrangement that the Ames Vacuum Brake Company have for applying the brake, it is very easily cut off.

Mr. Johann—I know on one road, where they were running sixteen passenger trains, they had an air pump on the engine, but they had no driver-brake, and did not have a brake on the tender. I asked why, and the explanation I got was that it wore the wheels flat, and that was the reason they didn't put it on the tender.

Mr. Hackney—We use our driver-brake all the time connected with the cars, for this reason: In a great many instances we have found that when it was an independent brake we lost control of it on account of its being out of order, and when an emergency arose the brake was of no use.

The President—On the Canada Pacific Railroad they have found nothing that satisfied them, on going down the long grades, like the Chatalier brake. Any ordinary form of driver-brake used on a long grade results in getting the tire so worn as to cause it to shift. You get rid of that very serious effect completely by using the Chatalier brake. So far as I know, I would only recommend it under those circumstances where the application of the brake is so continuous that injury might result, due to the friction generated between the shoe and the tire. On the question as to the relative value of grip or clip-brake shoes, and wedged or expansion-brake shoes, Mr. Webb, of the London and North Western, said in his letter to your committee that he had had very ample experience with both types, and he was not prepared to say that he would recommend the grip type in preference to the wedge type—that is, he had experienced no practical difficulties in the wedge type, the common type of American brake opening outwards.

Mr. Lauder—I should understand that the Chatalier brake should only be recommended possibly on long grades, where the grade is as high as 185 feet, and for a long distance. I can readily see that that must be a splendid appliance to be used in passing such mountains as the Santa Fe road have to pass in their lines. The Central Pacific, and in fact a great many of our Western roads, of course have grades to contend with that we in New England know nothing about; and I presume that that type of brake would be adapted to that service. With reference to this question of using the driver-brake to make all stops at all times, possibly I may be on the wrong track; but I still believe that I am right. I believe that the driver-brake on passenger trains should be used as an emergency brake; not that I believe that the brake injures the engine to any great extent through having it applied as often as it is applied to a train; but I do believe in passenger trains, where there are a large number of stops to make, especially, we should have something back of us for an emergency. Now, I may draw these conclusions from the fact that I am connected with a passenger road that has an immense local traffic, suburban traffic, where a large number of our trains have to make a great many stops; and having had several little experiences that were not very pleasant, which an auxiliary brake or a reserve brake would have prevented, I believe I am justified in using the brake as it is now applied, because the cost of putting on and maintaining that brake would be wiped out very quickly by accidents that had happened that this appliance would have prevented, had we not been using it to make our ordinary stops. Of course there is some force in the statement that Mr. Ball makes, that engineers will not keep the brake in order unless it is used occasionally. I have not had that trouble.

Mr. Ettigen—I will state that, two years ago, the road that I represent adopted the Westinghouse brake; and I was delegated to make experiments with reference to the increased wear on driving-boxes and side bars owing to the use of these brakes. We put two engines into the same service. Our road has these heavy grades of which Mr. Hackney speaks; and I made it my business to travel on those engines considerable, one with the brake and one without; and have since watched them very closely, and have never found any difference whatever. I would like to ask Mr. Hackney if this water-brake which he has in use is also applicable to cars, or does he use the Westinghouse brake?

Mr. Hackney—We use the Westinghouse air brake upon the cars.

Mr. Ettigen—I was thinking that on a road of that grade on which the brakes were applied the effect on cast iron wheels would be very disastrous.

Mr. Hackney—It does not apply to the wheels. It is a water-brake, and puts hot water into the cylinders.

Mr. Ettigen—Do you use the Westinghouse brakes on your cars when you go down the hill?

Mr. Hackney—Yes, sir. On a freight train or even on any passenger train, on a grade of 185 feet to the mile, we need something more than the ordinary appliances that we have for stopping trains to make it safe. 185 feet to the mile is an awful grade to manage.

Railway Collision.

In speaking of a collision on the London and Northwestern Railway, the *Engineer* explains the peculiar method by which the largest railroad corporation in the world seeks to circumvent the Board of Trade conditions. Each van on a train has been fitted with an automatic brake, that is to say, with a brake cylinder, a reservoir of enormous size carrying the store of power, and a distribution valve, which, if not a Westinghouse triple valve, it would appear is to answer the same purpose. The reservoir being exhausted by the large ejector on the engine, a store of power, registered on a gauge, is thus created, ready to act on the brake cylinder automatically, but which is held off by a small vacuum constantly maintained in the train pipe. There is also a cell in connection with the automatic valve, and the idea and object of the whole arrangement is, that should anything prevent the small vacuum being kept up in the train pipe—in other words, should the brake be in an untrustworthy condition—the valve in the van will drop, the bell will ring, and the automatic brake be instantly applied on the vans. This brake is called Webb's vacuum, and the arrangement is a recognition of the fact that one great defect of the simple vacuum brake is that it is likely to be rendered useless at any moment without warning. Instead, however, of also boldly recognizing that the only real safeguard is a brake entirely automatic, which will not allow a train to run unless all is in order, the London and North-Western Company, seeing the necessity for a tell-tale, is yet content to stop short of safety, and rest satisfied with ringing a bell and applying a brake to guards' vans, the object according to the instructions being that the guard may "endeavor to ascertain the cause" of failure and "advise the driver at the first stop." What is to be done in case the first stop should be caused unexpectedly by some emergency is not stated, and interesting as this warning to "look out for squalls" might be to the guard, it would be quite inadequate to stop the train.

As has been mentioned, the immediate cause of this accident was the failure of the large ejector on the locomotive, and it is worth noticing that simple as these instruments are claimed to be, they are by no means an uncommon cause of failure in vacuum brakes, and when they do fail they are likely to prove particularly mischievous. They at least have no bells to give warning, and their shortcomings are only ascertained when the brake is about to be used. In pressure brakes, on the other hand, the power is obtained by an air pump, and the superiority of this principle by which a store of power is accumulated for after use, either with the automatic or non-automatic systems, is very marked; for should a pump stop running the store remains until required, and no danger need be run. Ejectors are in reality not very dependable appliances, as a study of the Board of Trade brake returns suffices to show. Their capacity to create the very limited force selected for working the brakes varies with the pressure of steam, and even the height of the water in the boiler is an important matter. In this very case the writer states, "I thought the defect might arise from my having too much water in the boiler," as though implying this was a by no means uncommon cause. We have ourselves known of a case where a train overran a station on the Carlisle section about half a mile owing to the same reason, and in the Board of Trade returns we find the following: "The up limited mail was delayed at Crewe owing to the necessary vacuum not being maintained. This was caused by the engine boiler being too full of water, so that the ejector could not be worked. Neglect of engine 'washer out.'" Why, when discarding what was recently called in the House of Commons its "antediluvian chain brake," the London and North-Western Company should have stultified itself so far as to equip its stock with the apparatus we have been describing, it is, perhaps, not impossible to say. The apparatus upon which so much money is being expended, and which gives results so dangerous in practice, will certainly not suit the Board of Trade or the public, and it has not even the charm of that apparent simplicity which we have always been given to understand is the crowning merit of all vacuum brakes.

The Mitis process of making wrought iron and steel castings is attracting considerable attention throughout this country. The castings retain the full qualities of the wrought iron and steel scrap from which they are made. The AMERICAN MACHINIST was the first paper in this country to call particular attention to this new process, and explain it.

The two articles that seem to get the worst boycotting are bread and beer. The active and enterprising boycotter, who is anxious to keep up to the mark, finds it necessary to revise his list of anathematized bakers and brewers about every day. If all the boycotts were removed from bake shops, and a general boycott declared against beer shops, considerable good might be accomplished. But if a lot of workmen should organize a temperance club and stop drinking beer all at once, and advise others to do so, it would be easy to prove a conspiracy, under the penal code, to injure the saloon keepers' business. It may be safer to keep right on drinking or, perhaps, to "swear off" gradually and say nothing about it.

In the article on "Mixtures for Rolls," by S. Bolland, in our issue of July 10th, the second mixture for 10" and 12" rolls should be No. 3 iron 500 lbs., No. 4 iron 600 lbs., No. 5 iron 150 lbs., car wheel iron low 750 lbs.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.
JACKSON BAILEY, Vice-Pres't.
LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
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NEW YORK, JULY 31, 1886.

CONTENTS.

	PAGE
Fifteen-Inch Shaper	1
Fairbanks' Hand Lathe	1
Need of Patent Law Reform. By Henry B. Morris	1
Twenty-Inch Upright Drill	2
Getting Out Stavework. By Frank W. Barrows	2
The Hough Twist Drill Grinder	3
Firing Steam Boilers	3
Economy of Steam Engine Regulator	3
The Purves Piston Packing	4
Naphtha Engine	4
Writing on Foundry Practice. By Robert E. Masters	4
Arrangement of Steam Plants for Factories and Mills. By Wm. H. Hoffman	4
Printing Frame and Manner of Making Blue Prints. By C. L. Redfield	5
What One Young Man is Doing	5
Letters from Practical Men—Making a Cast-Iron Sheave. By P. S. Dingey—The Efficiency of Gear Teeth. By George B. Grant	6
Report of Master Mechanics Committee on Driving-Wheel Brakes	6
Railway Collisions	7
Some Industrial Exhibitions	8
Revolutionary Inventions	8
Literary Notes	8, 9
Questions and Answers	9
Business Specials	9
Manufactures	9
Machinists' Supplies and Iron	10

Some Industrial Exhibitions.

Industrial exhibitions have multiplied to such an extent in recent years that most people find it difficult to keep in mind all of them or even the principal ones. This year there are fewer than usual—not more than three or four in the whole country—that deserve general attention. With the exception of the American Institute Fair, regularly held every fall in this city, we know of no industrial exhibition in an Eastern city this year. The Star of Empire seems to be not only taking its way westward but drawing in its train the chief annual displays of the products of the factory and workshop. Most mechanical articles are made in the East, but the manufacturers who wish to place their goods before prospective buyers in industrial exhibitions must now look to the great cities of the West. Cincinnati has probably the widest known expositions. The one to be held from the 1st of next September to the 9th of October will be the thirteenth, and the beginning of a "new series" inasmuch as the plan of giving competitive awards has been discontinued. Goods will be entered for exhibition only, and a fruitful cause of trouble will thereby be avoided. The exhibition managers have decided to boycott medals, diplomas, silver plate and "honorable mention," and are certain to avoid a great deal of boycotting on the part of exhibitors who would not obtain first-class awards. Goods will be received on and after August 11th. The shafting will be run at 200 revolutions a minute, and exhibitors can get split driving pulleys and belts at cost if they apply in time. As machinery is always the main feature of these expositions at Cincinnati, those sending machinery to display, either in motion or at rest, may be assured that proper facilities will be afforded them.

Exhibition enterprise has penetrated farther northwest than ever before, and Minneapolis, which has but lately taken rank among large cities, is erecting a structure for industrial exhibitions that shall be second to none of them in size and general appointments for the purpose intended. The first exposition will open August 23d and close October 2nd. Ample preparations are being made to afford the best possible exhibit to machinery and tools. The people of that section of the country are not slow as may be seen by the growth of Minneapolis, which in 1880 had but a few more than 46,000 people, and which now has about three times that number. This rate of progress is still sustained, and of course the quantity of manufactured wares absorbed by that section of the country is by no means small. The new exposition will be largely attended, and exhibitors should reap substantial benefits. The exhibition at Louisville, Ky., opens in August and closes in October. The building is a large one, and previous displays have been good.

Outside the United States the impression seems to prevail that our people are good patrons of exhibitions. An American Exhibition is to be held in London from May 2, 1887, to the 31st of the next October. It has a long list of officers, headed by Grover Cleveland, Honorary President. The headquarters in the United States is at 702 Chestnut street, Philadelphia. It is to be devoted to products of this country alone. We notice that quite a number of prominent manufacturers have already taken space to exhibit. Applications will be received to the 1st of next March, but if the articles are to be classified application must be made by the 1st of November this year. The expectation is that goods at this exhibition will be viewed by people from most countries of Europe and the English colonies, as well as by those living in or near London.

The purpose of the exhibition is "to stimulate and extend the export trade of the United States, and to quicken the flow of foreign capital to this country for the development of its natural wealth and resources."

The AMERICAN MACHINIST advocated the necessity for elevator inspection for some years before it became a law in New York City. The argument was that the elevator was even more a source of danger than the uninspected steam boiler. While it is not pleasant to know that of the 435 passenger elevators inspected for the quarter ending with June, 41 were found defective, it is satisfactory to find that inspection ferreted out these defects before accidents resulted from them.

Trade news that reaches us from Chicago looks blue upon a superficial view. This does not refer so much to the character of the news as the way it is served. It relates to our exchanges from that city which wear overcoats in both hot and cold weather. The *Railway Review* presents a light blue tint, while the wrap of the *American Artisan* is even a lighter blue, heightened, however, by deep blue ink. The *American Engineer* travels in a top coat almost as blue as indigo, and the *Railway Age* presents a somewhat subdued tint of blue. Various shades of blueness may be observed upon other exchanges, and we don't expect any change until cold weather sets in—perhaps not then.

Revolutionary Inventions.

While the crop of inventions that are to revolutionize some industry—with a capital of ten million dollars or so—is not coming forward so rapidly as usual this year, there is no reason to believe that there will not be the customary seed time and harvest. But there is some evidence that booming wild-cat schemes in the mechanical line will not be so profitable in the future as in the past. Not that people are likely to seriously object to being humbugged, but they like a variety in the process. Clairvoyants, so called, used to do a thriving business in dealing out instructions for finding buried treasure and the like, all for the sum of a dollar or two, but finally it began to occur to those who invested, that if the "mediums" knew these things so well they were selling certainties to get rich at remarkably low figures.

When men have—on their own evidence—discovered revolutionary mechanical or engineering principles there is room for the same suspicion, if they propose to lead stockholders to positive riches for a few dollars. When such inventions, or discoveries, are made in these times there is little probability of immense capital being required to develop them, especially not to go to the extent of satisfactorily demonstrating their utility. We have in mind at this time three of these revolutionary schemes, all brought out within the past three years, now all dead beyond the possibility of resurrection. In each instance immense capital was being looked after—in one case at least twenty-five million dollars—sure to be returned a hundredfold almost immediately. As a matter of fact there were in the country a thousand manufacturers in the line of these alleged inventions, either of whom had sufficient capital to push them all they could have been pushed, and either of whom would have investigated the matter, and if a fraction of the value claimed had been found would have pushed it almost at the inventor's own terms.

When the first that is heard of an invention is through efforts to start a gigantic company, it is not generally worth further attention. There may be exceptions to this, but a glance at the meritorious things in the mechanical line that have been brought out will show that not many of them have been pushed by gigantic stock companies. The inevitable moral is to avoid assisting to push things in this way.

A call has been issued by the "Union for the Improvement of the Canals" for a canal convention at Syracuse, Aug. 25th. The call is quite liberal as regards qualifications of delegates, and the convention should be a large one. It is desired that the canals shall be improved by lengthening the locks and deepening the channel. Canals in this State carry large quantities of produce between the East and West, and keep down railroad freight rates to reasonable figures. Improvement of the canals is a good object to contend for and we suggest that the convention recommend that if the work is undertaken by the State, every able bodied convict not needed for work in the prisons should be sent to work upon the canals. It would be an enterprise that would not interfere with private industry.

The ironworkers' scale has been signed at Pittsburgh for another year, the slight points of disagreement having been adjusted. This gives one of the greatest elements of stability to the manufactured iron business, for the workmen's union on one hand, and the manufacturers' union on the other, are so strong that there is no fear of either breaking the wages contract.

The practice of giving written testimonials of the great value of mechanical articles by those who have used them is greatly overdone. Such recommendations are often misleading, even when given with the best of intentions. At the recent convention of master mechanics in Boston, a resolution deprecating the giving of any testimonials or recommendatory letters for publication was adopted unanimously. They were of the opinion that such matters should be restricted to letters of inquiry. Of course, the answer to such inquiries might be used as testimonials for publication, unless it should be stipulated that they should be kept private. We have heard of cases where parties would be very glad to recall testimonials that they had written, but could not. The exercise of a great deal of caution is desirable in writing commendatory letters for public use.

It is not one of the re-assuring signs of the times that the daily press—such of it as advocates equality before the law for all—feels constrained to congratulate the people on the fact that it has at last been found possible to obtain a verdict against the Western Union Telegraph Company. As the verdict was on suit of the receiver of another telegraph company—the Bankers and Merchants'—the decision of the jury loses much of its pertinence. Still it is a good thing as far as it goes.

The *Manufacturers' Gazette* says "a new locomotive, involving an outlay of say $25,000, is turned out each month" in the Consolidated Railroad shops at New Haven. Many master mechanics believe they can build better and cheaper locomotives than can be bought from regular locomotive shops, but at present prices of labor and materials wherever it costs $25,000 apiece to build locomotives in a railroad shop we should say they had better stop new construction as soon as possible. At that rate of expense for everything required to run a road, the most prosperous railroads in the country would soon have receivers.

We received, on July 8, 1886, a dilapidated and bedraggled looking letter, containing a money order and renewal of yearly subscription sent us in March last by Wm. F. Watson, Southwick, Sunderland, England. The letter was postmarked March 4, and was accompanied by the small printed label, which had already become quite familiar to us, denoting that the enclosure came by the ill-fated steamship Oregon, which was lost four months ago. The present find is part of the contents of the latest mail bag found a few days since, but is quite useless to us, the sender having long since forwarded a duplicate money order by a more fortunate vessel. We have returned the original, so strangely preserved, to Mr. Watson, for preservation as a souvenir, should he feel that its maritime adventures entitle it to safe keeping.

Germany was the first European country to recognize the importance of a certain amount of technical training for artisans, and to provide for it. As a result, no European country has, during the past ten years, made equal progress with that country in manufacturing. At the same time, there are two purely technically-trained students in Germany for every one that can find satisfactory employment.

Interests that Want Prison Contracts Abolished.

General Brinkerhoff, of Ohio, has recently said of prisons "that contract labor only requires brutality and club to make it self-supporting." It is promising to have so eminent a penologist assent to the condemnation of a system which for quite other reasons has been proscribed by labor organizations, and probably, therefore, by several of legislatures. While there is reason to distrust the one-sidedness of conclusions reached by men having only a single interest, that distrust must vanish when the conclusions are supported by several interests.—*Bradstreet's.*

Just so. When the people of the State of New York voted directly upon the proposition to "abolish contract labor in prisons," and decided *yes* by nearly 140,000 majority, there was not much doubt that the conclusion was "supported by several interests." Nor is there much doubt that the several interests in other States would cause just such a decision if the question were put to a direct vote. The cry of the prison-contract ring is that the abolition of the contract system is demanded only by labor organizations (supplemented, perhaps, by an occasional Ohio general), and that most other people are favorable to its continuance. They presume that the people have short memories about decisions rendered by the ballot, but we are surprised that *Bradstreet's*, which is nothing if not historical and statistical, should ignore such a decision by a State of over six million people, in discussing the prison-labor question, and ascribe the anti-contract acts of several legislatures wholly to the influence of labor organizations.

Not a Good Custom.

If it is the custom of the day to dispute the existence of many things of long ago which we have learned to believe in, it is quite as much the custom to demonstrate that there is nothing new in the present. This is especially true of inventions presumably novel. In these there appears just now to be a positive mania for overhauling old records to show that the inventor is without credit in the matter. It is generally comparatively easy to rake over these old volumes, and to twist the language into something enough different from what it really is to show the antiquity of almost anything. But this is hardly profitable for any purpose.

So far as we can see, if a man adds something to a machine that makes it do better work, he is entitled to the credit, and, in equity, to a share of the pecuniary benefit arising from the improvement, without reference to whether or not some one essayed to do the same thing ten or a hundred years ago and failed. The evidence that an inventor has brought something into use not previously used ought to be all-sufficient. If it could be shown beyond dispute that James Watt fully comprehended the advantages of the automatic cut-off steam engine, it would take nothing from the credit due those whose invention and skill have brought it into common use.

For every valuable invention brought out there are at least a thousand persons who "had thought of it before." The only real test in such matters is, did their thinking of it prove of advantage to any one? This dog-in-the-manger way of looking at these things is both absurd and hurtful.

It is believed that the immense tower, 1,000 feet high, that is to be erected in Paris, although principally built as a matter of curiosity and to draw people to the coming exposition, will render important services to the cause of science. Observations can, it is reasoned, be made at this height that have hitherto been impracticable.

English scientific journals are going to considerable pains to show the impracticability of attaining a speed of forty knots an hour in ocean-going steamships, as has recently been declared practicable by some writers on the subject. *Engineer* says economical objections alone would be fatal, to say nothing of engineering impossibilities.

Literary Notes.

We have received a copy of *Shoppell's Modern Houses*, for July, 1886, a large pamphlet published quarterly by the Co-operative Building Plan Association, 191 Broadway, New York. We cannot see that there is anything specially co-operative in the publication except the name of its publishers, but recognize it as being a valuable publication. It contains illustrations and detailed plans of a large number of country-fashion houses, with estimates of cost. Many of the designs are very attractive. The price of the book is $1 a number or $4 a year. The book has accompanying it a small paper model which can be cut out and put together, so as to make a complete cottage in miniature.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(281) A. G., Ansonia, Conn., writes: I would like to know your opinion of the electric motor, and which would be the best for the purpose of driving a small boat, 25 feet long and 5 feet beam? *A.*—In the present state of the art we should not advise you to think of an electric motor for a boat. 2. What do you think of the new engine in which naphtha is used as fuel? *A.*—We think if you want to build a small boat it will be worth your while to examine the merits of the naphtha engine.

(282) J. B., Baltimore, Md., asks: What should be the diameter of the valve stem for a 4¼′ x7″ engine; steam pressure, 80 lbs.; revolutions, 225 per minute? *A.*—The pressure on the valve and the length of the stem should govern the size. On general principles, we should say $\frac{5}{8}$″. 2. How do you estimate the power required to drive dynamos of different sizes? *A.*—The only way you can come at the power required to drive dynamos made by different builders is to get the information from those who build them. 3. Is the friction of a vertical engine greater or less than that of a horizontal engine? *A.*—There is but little difference. What little difference there is, is generally in favor of the vertical engine. 4. Is it possible to connect two engines to one shaft and have them run so there will be no variation in speed? *A.*—We suppose you mean to connect by belt. In this case there will be a slight variation in speed, but it will not be, of necessity, of practical consequence.

(283) A. B., Minneapolis, Minn., writes: A question has come up as to the difference between an inch square and a square inch. Some claim that an inch square is the same as a cubic inch. Also, what is the difference between 2 square inches and 2 inches square? *A.*—Square measure relates to measure of *surface* only. You seem to confound it with cubic measure, which relates to measure of volume. A *square* is a figure with four equal sides, and to compute the surface we multiply two of the sides together. Thus the surface of a figure one inch square is $1 \times 1 = 1$ square inch. Similarly, the surface of a square 2 inches on each of its sides is $2 \times 2 = 4$ inches. A square, each of its sides 1.4142+ inch would have a surface of 2 square inches.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Patent Att'y, H. W. T. Jenner, Washington, D. C.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

Veneer machines, with latest improvements, Farrel F'dy & Mach. Co., Ansonia, Ct. Send for circular.

20,000 addresses of steam users and users of mach. in 10 States, $10. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See July 24, p. 14. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

"Hints to Steam Users, Engineers and Firemen." A 100-page book on care of steam boilers; just issued; containing useful rules, tables, etc; a valuable book for engineers; sent on receipt of 25 cts. in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding, if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

MANUFACTURES.

Scott, Donnell & Scott will build a cotton mill at Graham, N. C.

Newell Bros. are planning to enlarge their button factory at Springfield, Mass.

The Waterbury (Conn.) Watch Co. will erect an addition 40x100 feet.

The Goveland Foundry, Dighton, Mass., is enlarging. The product is stoves.

Union Furniture Co., Union, S. C., have broken ground for their new factory.

W. H. Whitmore & Co., are to establish a shoe factory in Raleigh, N. C., to employ 50 men.

The South Florida Foundry and Machine Works are erecting a new building at Orlando, Fla.

Nicholes & Archelaus, Brewton, Ala., will erect a shop to make wood-working machinery.

It is said the Baltimore & Ohio Railroad will enlarge its rolling mills at Cumberland, Md.

The Americus, Preston & Lumpkin Railroad will build car repair shops at Americus, Ga., to cost $15,000.

The Chesapeake, Ohio & Southwestern Railroad Co., will spend $40,000 in erecting car shops at Louisville, Ky.

The Southern Brewing Co., New Orleans, La., are building an additional brewery, five stories, 62x64 feet, to cost about $80,000.

The Mississippi Valley Railroad will soon begin work on a freight car repair shop, 60x250 feet, at Vicksburg, Miss.

Thomas Breen, Knowlton, Pa., offers to erect car building works at Portsmouth, Va., if the citizens of that city will subscribe $100,000.

E. D. Latta & Bro., Charlotte, N. C., will add steam power to drive 100 sewing machines in their clothing factory.

The Old Dominion Nail and Iron Works Company, of Richmond, Va., contemplate building a Bessemer steel plant.

The Sloss Furnace Co., of Birmingham, Ala., contemplate enlarging and improving one of their furnaces at a cost of $30,000.

Joseph Glatz, 55 Maiden Lane, New York, will erect a five-story brick factory on Kent street, corner Division ave., Brooklyn, N. Y. It will cost $23,000.

The Schenectady Locomotive Works now have at work more than 950 men. From 16 to 18 engines are turned out every month. The monthly payment roll amounts to nearly $40,000.

Bath, Me., has voted to have a water supply. This is eminently proper. They should either have a good water supply or change the name of the town.

Gordon, Stroble & Laureau, engineers, of Philadelphia, have closed with the Jefferson Iron Company for the building of a Bessemer plant at Steubenville.

Fifty-three miles of wire rope for cable railroad lines in Melbourne, Australia, have been ordered in this country. It is expected that the cars will also be bought in this country.

The Hallett & Davis Piano Mfg. Co., of Boston, have ordered 120 horse-power of the Moore type of water-tube boilers from the National Water-Tube Boiler Co., New Brunswick, N. J.

The co-operative nail mill, at Steubenville, Ohio, will have to close down because the price of plate-iron has risen. They expect to build a mill and make their own muck iron, when nail making will be resumed.

The Union Iron Works Co., Selma, Ala., will build a new machine shop, 40x100 feet, and a new foundry, same size. Their present buildings will be used for other work connected with the business.

The Lonsdale Co., Lonsdale, R. I., will erect a other cotton mill, 686x101 feet, four stories high. It will be a 65,000 spindle mill, and will be driven by two Corliss engines of 1,300 horse-power together.

At Newport News, Va., a site has been selected for an immense dry dock, capable of docking the largest ocean steamships, which, in connection with the necessary machine shops, will cost about $600,000.

It is reported that the Long Fiber Cotton Gin Co., Washington, D. C., will establish factories at Woodlawn, Ala., for manufacturing cotton gins. Capital stock, $1,000,000. J. F. Dezendorf, Washington, D. C., president.

The Fitchburg Railroad Company has just closed the contracts for a group of three repair shops near the new engine house on Crescent street, Worcester, Mass. The largest will be 70x40 feet, one 35 feet square, and one long, narrow one 17 feet by 50.

Joseph Dixon Crucible Co., Jersey City, N. J., have issued a budget of original printed matter relating to the various uses of plumbago (graphite or black lead), as a facing in foundry work, as a lubricant, as a preservative paint, and as an ingredient of lubricating greases, which they will send postpaid to any applicant.

Currier & Snyder, Worcester, Mass., have issued an illustrated catalogue of their upright drills, of which they make an exclusive specialty. There are various sizes and patterns represented. Some testimonials, with quite a list of parties using these drills, are published for reference.

Jas. Swain & Co. have recently started a general machine shop corner Thirty-first and Smallman streets, Pittsburgh. Mr. Swain has been in the employ of the Pittsburgh Steel Casting Co. for the last eight years, but has now started in business for himself.—*American Manufacturer.*

The Hampden Watch Co. are building a wooden block in Springfield, Mass. It is expected the building will be ready for occupancy in a few months. The company are considering the manufacture of small watches for women. The new departure would necessitate the employment of a number of new hands.

The Dickson Mfg. Co., of which James P. Dickson is president and manager, H. O. Nourse, 96 Lake street, Chicago, Western sales agent, and Robert R. Zell, 112 Liberty street, New York, Eastern sales agent, are making the building of the Zell safety boilers a specialty, and have fitted up their Wilkesbarre (Pa.) shops for this purpose. Are now building eleven boilers on various orders, ranging from 125 to 1,000 horse-power.

The City of Charlotte, N. C., wants to give to a responsible company a liberal franchise to put a line of street cars through the principal streets of the city. An electric light company has been started there, and promises gratifying success. A water-works has been in successful operation about three years, and the city has just contracted for a complete sewerage system. Address Wm. Johnston, Mayor.

Dr. Waugh, of Belleville, has contracted with Gordon, Stroble & Laureau, of Pittsburgh and Philadelphia, for the erection of a steel plant that will turn out 300 tons per day. The Waugh mill at Belleville has 100 nail machines at present in operation on the Mingo scale. The object of erecting the steel works is to furnish this mill steel plates, and also to make billets and other articles. The plant is to be completed within five months.

Park Bros. & Co., Pittsburg, have decided to begin the erection at an early date of a blast furnace of most modern construction. The furnace will be built on Herr's Island, in the Allegheny river, nearly opposite to their steel works, and the product, which will be high-grade pig, will be used in the manufacture of open-hearth and other steels. This furnace will give them a control of the character of their material, which they do not now have.

A year ago this time the total stock of printing cloths in this country was 1,178,000 pieces, of which 344,000 pieces were piled up in Fall River. The market was sluggish at three cents, and the mills there were stopping to curtail production. Now the total stock of printing cloths in the country—only 311,000 pieces—is the smallest at any date during the last five years, and is less than a fortnight's production of Fall River looms.—*Boston Commercial Bulletin.*

The Watts-Campbell Co., Newark, N. J., have issued a new and enlarged circular of their Corliss steam engines. In addition to a description of various parts peculiar to the engines built by this company, the catalogue contains information of a general character, and tables that will be found convenient and useful. All the engravings are new. The circular is admirably printed on paper of a superior quality, and bound in flexible cloth, which will preserve it against hard usage.

The *Baltimore Manufacturers' Record* reviews the industrial progress of the South during the last six months. There have been added to the manufacturing industries during that time 40 foundries and machine shops, 30 ice factories, 1 Bessemer steel rail mill, 8 miscellaneous iron works, including iron pipe works, bridge and bolt works, 3 stove foundries, 15 gas works, 7 agricultural implement works, 11 carriage and wagon factories, 8 cotton mills, 18 furniture factories, 48 flour mills, 248 lumber mills, and a large number of other smaller enterprises.

Machinists' Supplies and Iron.

NEW YORK, July 15, 1886.

The market for supplies and stock is without noticeable change, still there is not the comparative decrease usually noticeable in the hot months. Judged on this basis prospects for future trade may be accounted good.

Iron—Transactions in American Pig have been quiet during the past week. There is some little inclination among buyers to stock up for future use, but so far this inclination has mostly found expression in increased inquiries rather than in orders. The inclination of holders is to maintain prices firm, and to hope for a slight advance in the near future. We quote standard brands: No. 1 X Foundry, $18 to $18.50: No. 2, $17 to $17.50; Grey Forge, $16 to $16.50.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Tool-maker, experienced on small dies for sheet metal, wishes work. Address Box 27, AM. MACHINIST.

Situation wanted by good mechanic and draftsman. Address "Jesmond," AM. MACHINIST.

Wanted—Position as foreman, by an experienced machine-shop foreman. Address, West, AM. MACHT.

Wanted—Correspondence with parties wanting machine-shop foreman. G. E. C., AM. MACHINIST.

Head draftsman and designer of special tools and automatic machinery desires engagement in New York. Box 17, AM. MACHINIST.

Wanted—A position as shipping clerk in manufacturing concern; 10 years' experience in packing and shipping. Address X, Box 824, Ansonia, Conn.

Wanted—Situation as foreman or journeyman pattern-maker; locomotive works preferred; best of references. Pattern-maker, AM. MACHINIST.

Wanted—A man that is a good machinist, and understands building wire nail machines. Address Wire Nail, AM. MACHINIST.

Tool and model-maker, 10 years' experience, mostly with E. Remington & Sons, wants steady situation; fine work preferred; valuable micrometer patent for sale. Box 475, Ilion, N. Y.

Wanted—Good moulders for cylinders, fly-wheels and other heavy work; none but first-class moulders need apply. Address Wm. Bayley & Co., Milwaukee, Wis.

A mech. engineer and draftsman, thoroughly competent, with varied experience in designing and construction of engines, boilers, machinery, structural work, etc., is open for engagement. "M. E," AM. MACHT.

Wanted—By a man of 35, a position as foreman of a tool or engine-building shop; experienced in handling men and estimating; now occupying similar position; best references, Address "N," AM. MACHINIST.

Wanted—A middle-aged mechanical man, experienced in manufacturing and management of men, to take charge of a floor with about 40 men. Works in country town. Apply to H. M. L., P. O. Box 1119, New York City.

Wanted—Traveling salesmen selling to steam users, machinery and mill supply houses and the hardware trade, to write for my terms and commission on some fast-selling articles. Address J. L. K., AM. MACHINIST.

Wanted—A first-class machinist to take an interest in an established iron works in a Western city; no capital required; must be acquainted with engine and boiler work, and capable of taking charge of mechanical part of business. Address "Western," AM. MACHINIST.

Wanted—Situation to travel or take charge of shop; thoroughly acquainted with all classes of engines and supplies; also agricultural machinery; 12 years' experience as supt. and foreman; reference given as to ability and habits. Address Box 18, AM. MACHINIST.

A young man, experienced in the manufacture of regular and special machine tools, familiar with pattern and foundry work, a practical draftsman and general machinist, will give further particulars and references to parties in or near New York, who may be in need of a man with above qualifications. Box 16, AM. MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Steel stamps, stencils, burning brands, and brass checks. T. M. Parker, Hartford, Conn.

Light mach'y of all kinds built at short notice. Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

Send for estimates of high-speed compound engines for stationary and marine service. Crist Engine Works, 140 Baxter street, N. Y.

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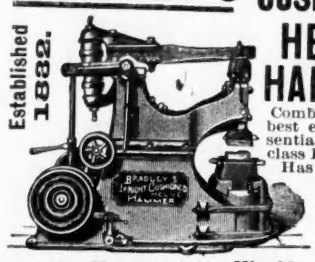

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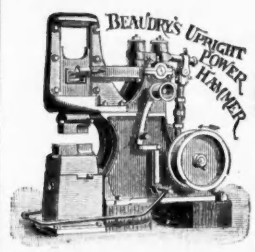

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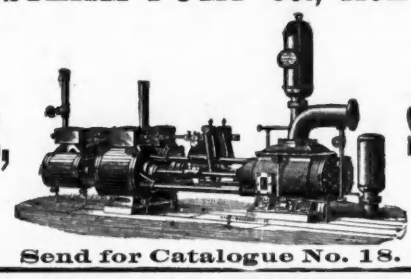

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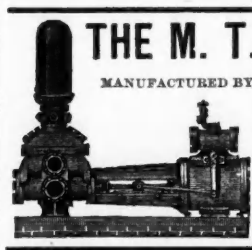

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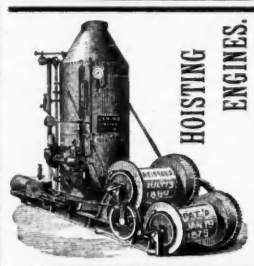

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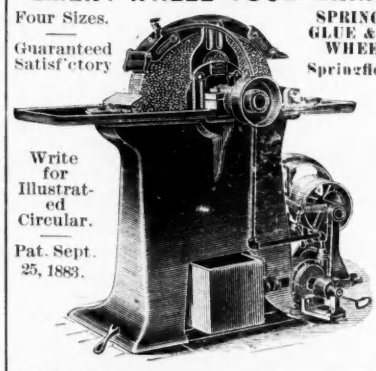

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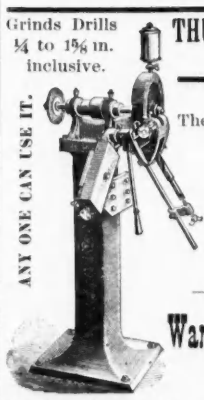

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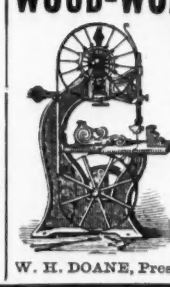

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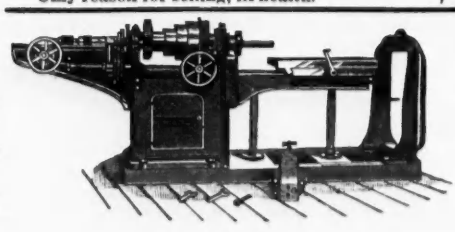

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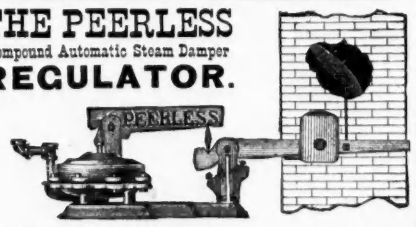

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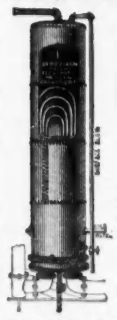

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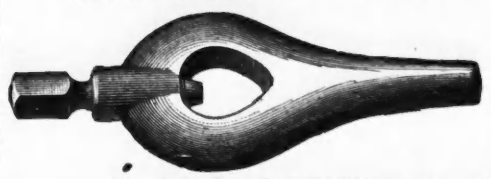

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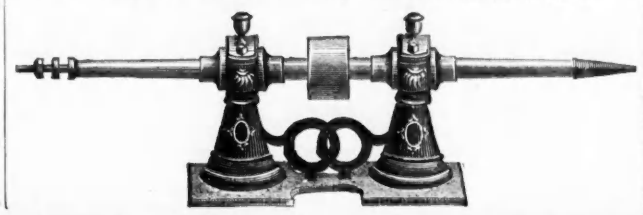

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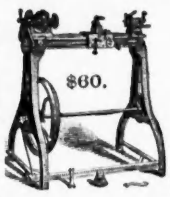

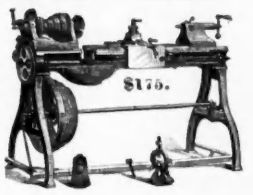

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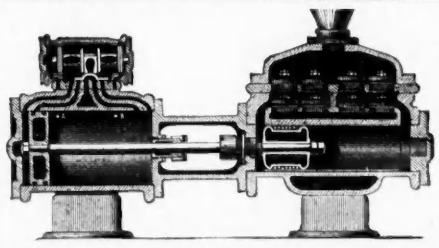

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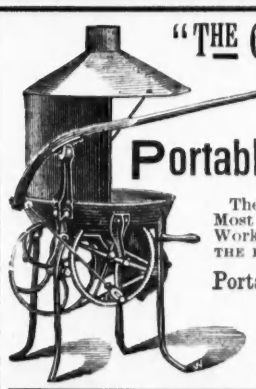

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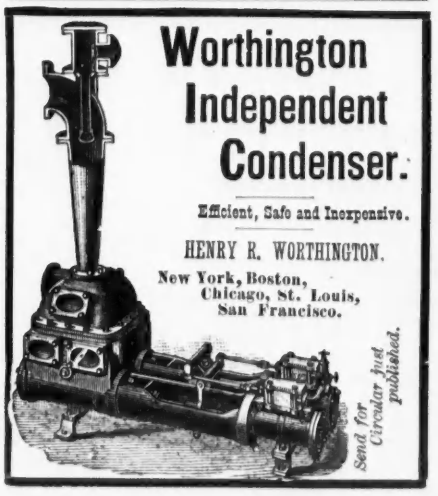

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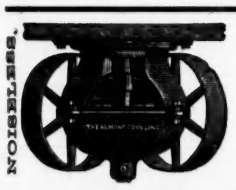
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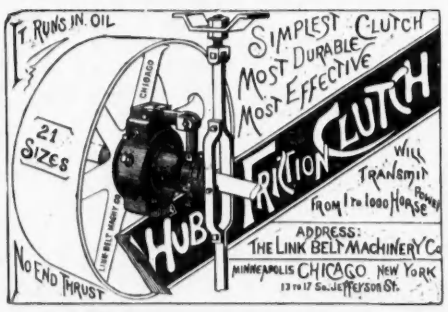

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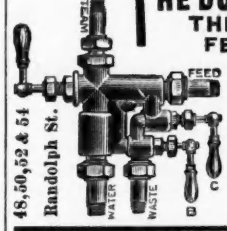

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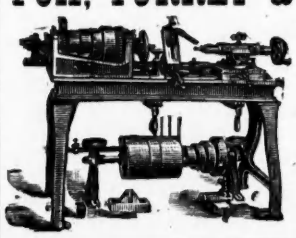
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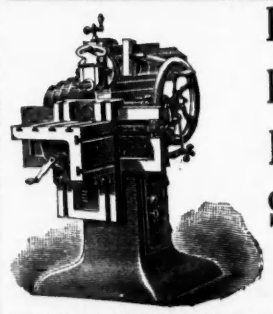
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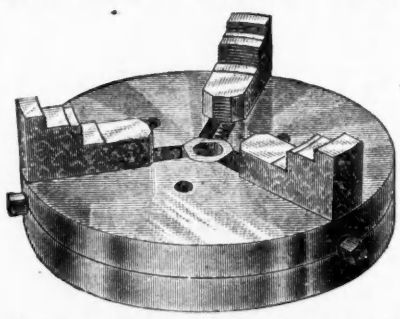
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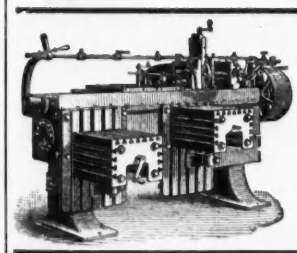
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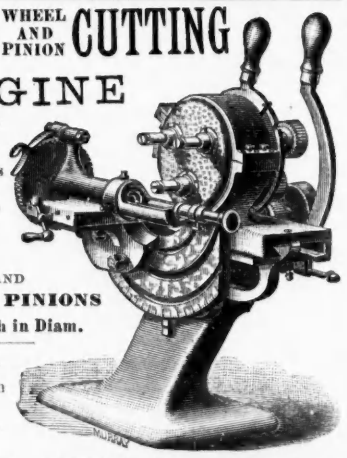

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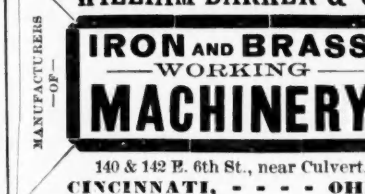

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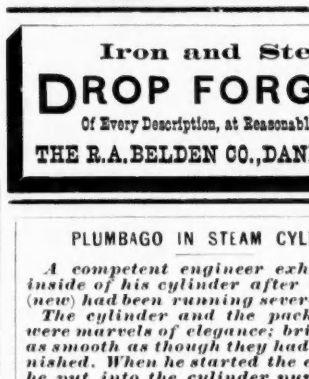

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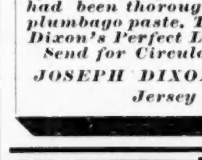

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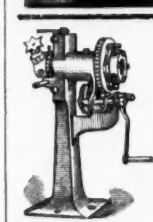

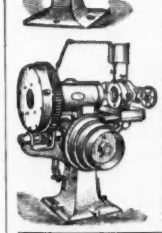

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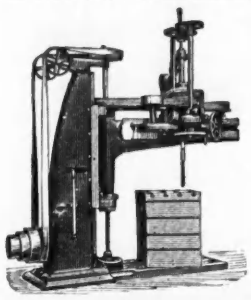

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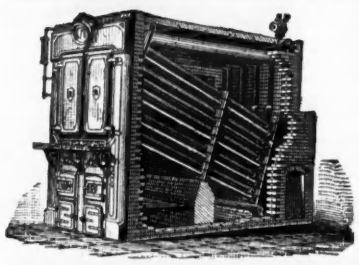

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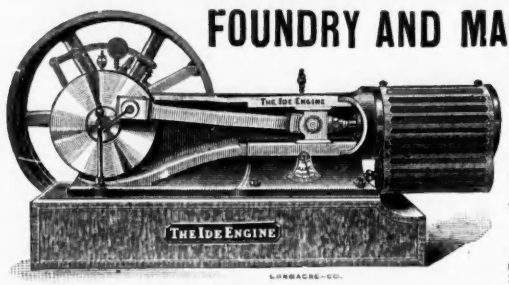

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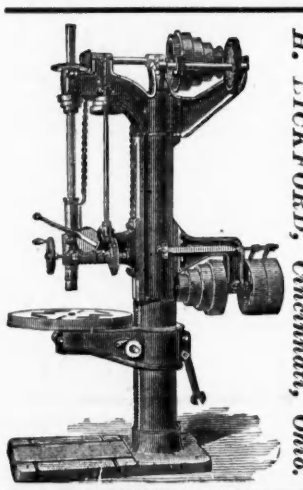

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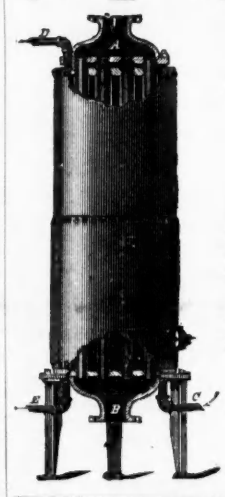

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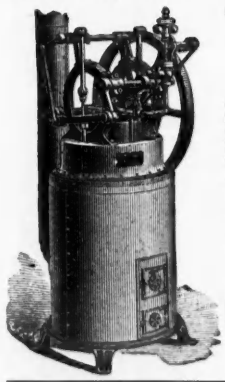

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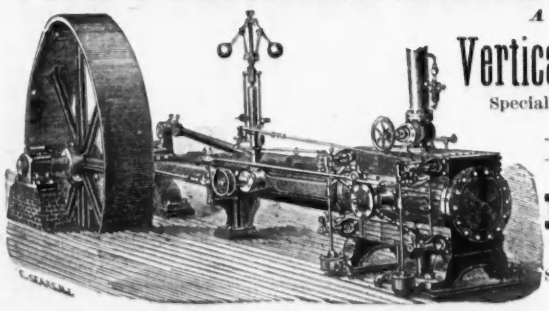

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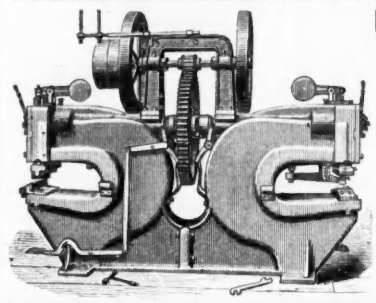

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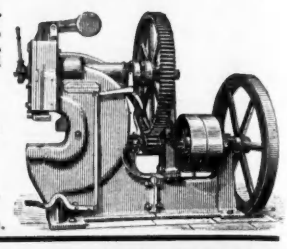

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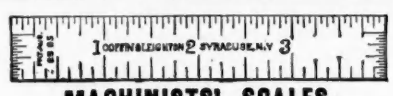

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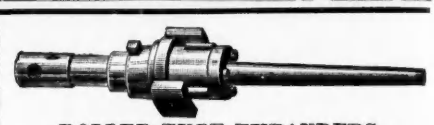

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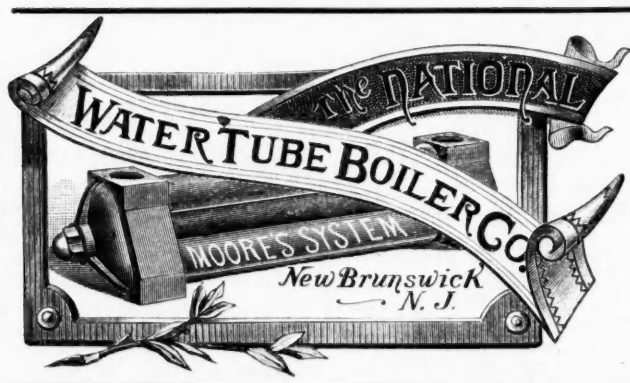

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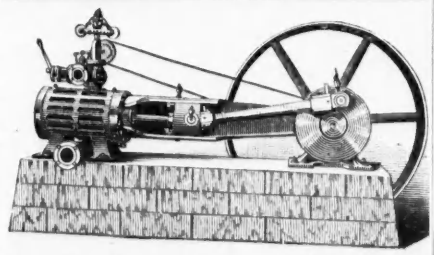

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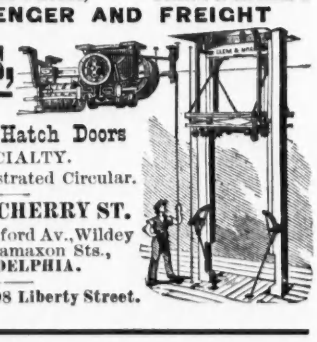

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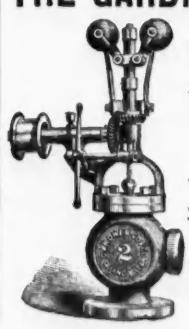

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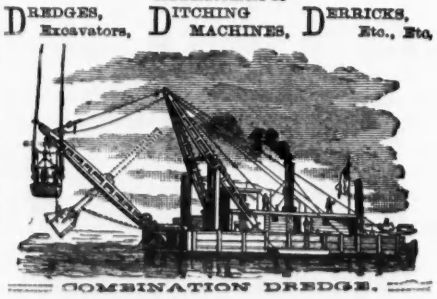

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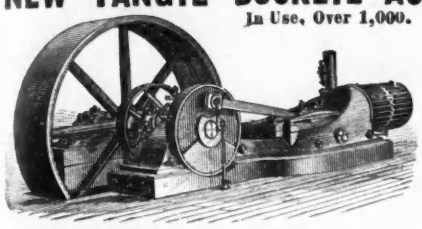

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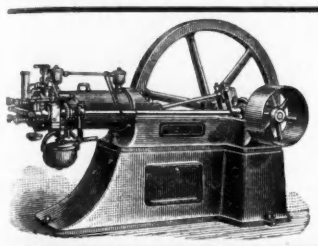

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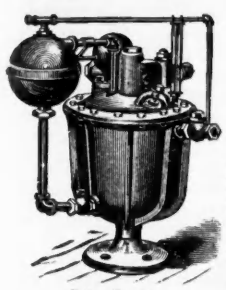

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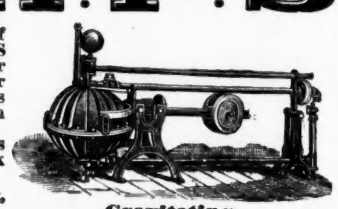

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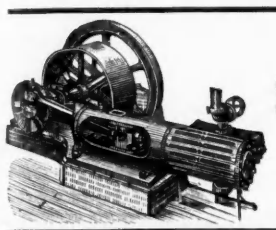

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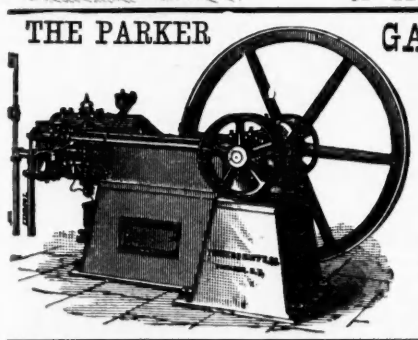

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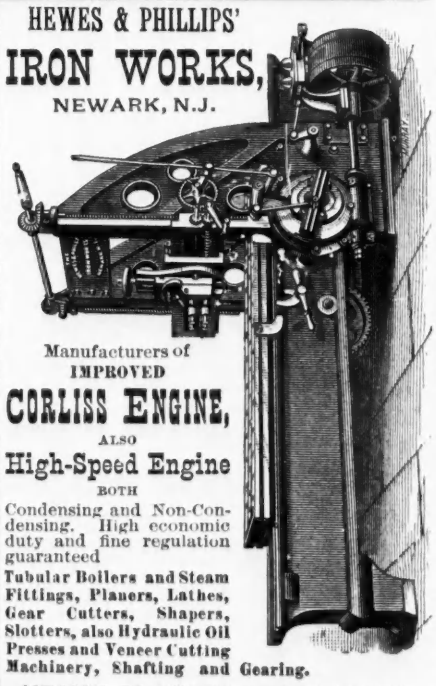

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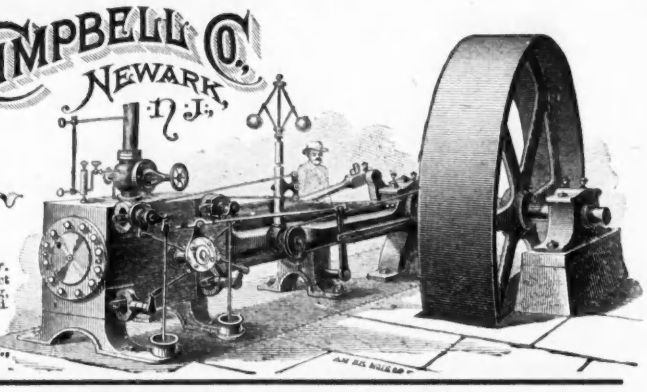

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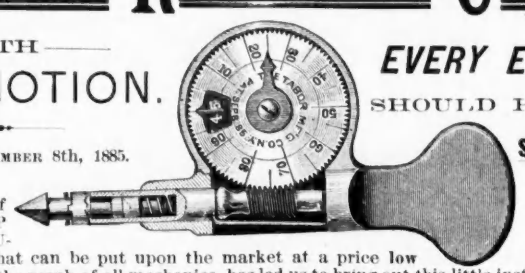

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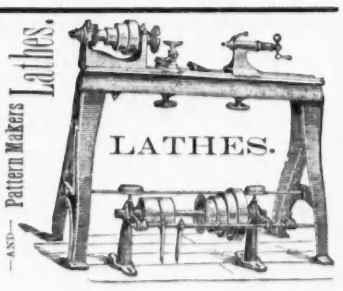

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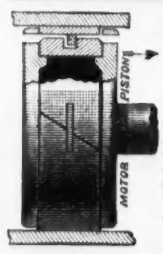

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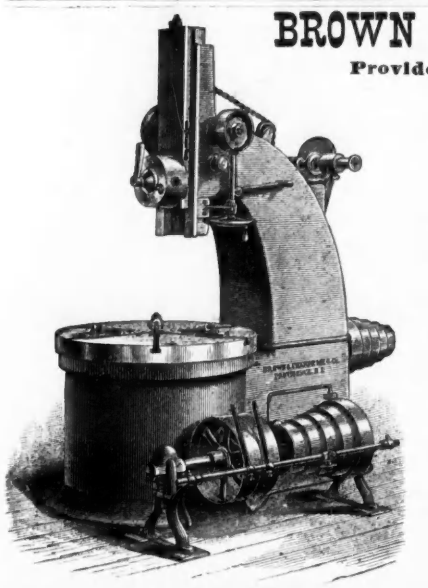

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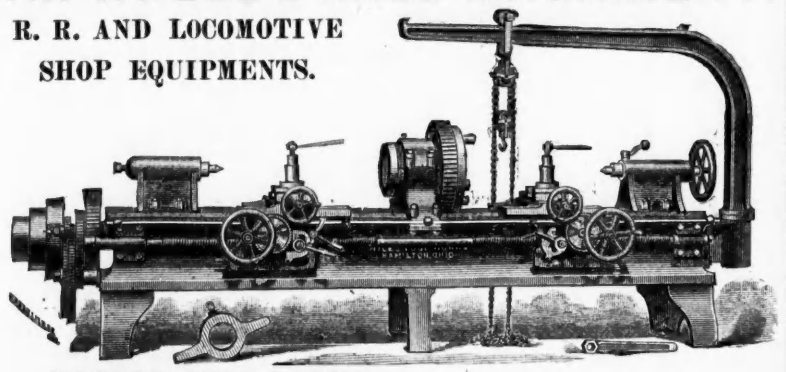

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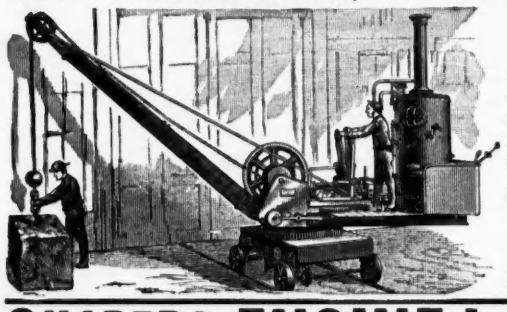

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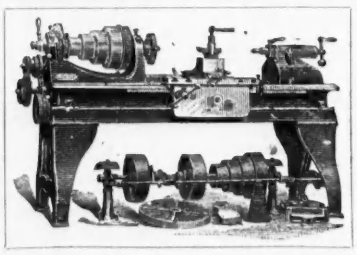

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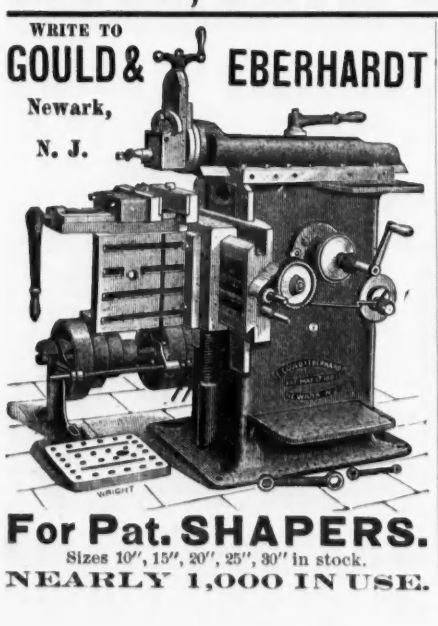

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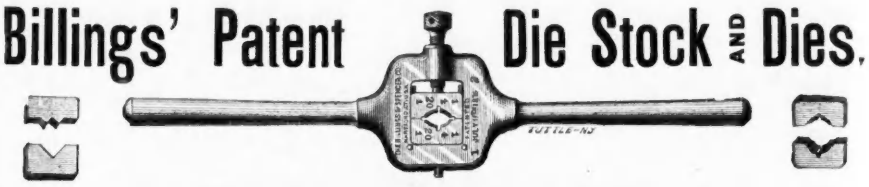

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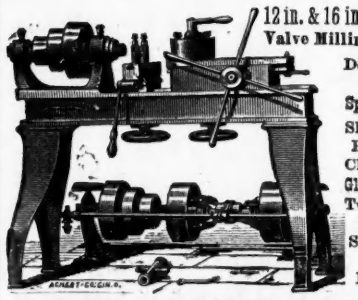

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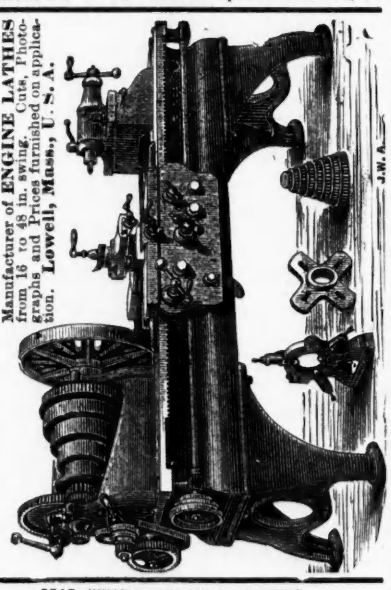

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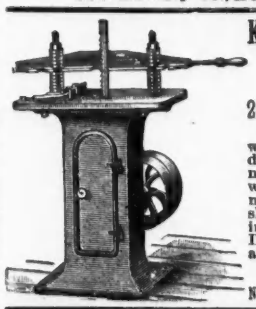

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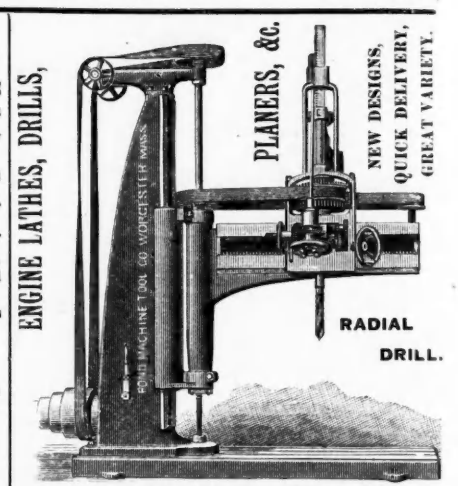

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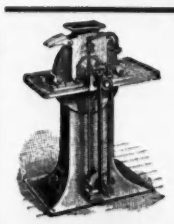

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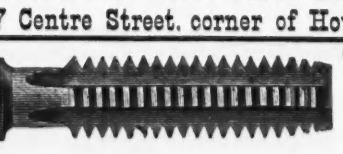

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